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Atoms and Ions in the Sun[1]

Charlotte E. Moore
National Bureau of Standards, Washington 25, D.C.

THE topic "Cosmic Abundance of Chemical Elements" is one of general conversation among chemists, physicists, astronomers, geophysicists, geochemists, astrophysicists, and specialists in related fields. In one respect, our nearest "cosmic laboratory" is the sun. It may be worth while, therefore, to direct attention to detailed solar spectrum work on which some determinations of cosmic abundances of elements are based. The subject is old but far from exhausted and is one in which new vistas are continually opening up.

Observational Material

Visible region. As early as 1895 (*1*), Rowland published a remarkably accurate description of solar spectrum wavelengths between 3050 A and 6600 A. His wavelength scale has been converted to the international system of standards (*2*), and many of the lines have been remeasured by later observers, but his compendium has not been replaced *in toto* today. Although his observations extended from 2975 A to 7330 A, his spectrograms lacked sensitivity in the long-wave region. Both the infrared and ultraviolet regions have since been explored and extended with modern facilities and equipment.

Infrared region. Studies of the photographic infrared region have been particularly rewarding. Present high-dispersion spectrograms reveal 7400 lines between 6600 A and 13,495 A, the limit of the photographic range. Meggers first extended precise observations to 9000 A (*3*), and Babcock and his associates at Mount Wilson succeeded in carrying them to longer waves (*4*). Important lines of the nonmetals are conspicuous in this region. Rowland was unable to find these because of his limited solar observations in the infrared.

This fascinating study is, however, not restricted to the long-wave limit imposed by the photographic plate. Photometric observations made with PbS cells and other suitable heat-detectors extend still farther toward the radio range. A photometric atlas of the solar spectrum between 8465 A and 25,242 A (2.5 μ) has been prepared at the McMath-Hulbert Observatory in Michigan by Mohler, Pierce, McMath, and Goldberg (*5*). Migeotte and his collaborators, working at the International Scientific Station at Jungfraujoch, Switzerland, are preparing a similar atlas to cover the interval 2.8 μ to 24 μ (*6*). In the gap between these two atlases, 2.5 μ to 2.8 μ, strong bands ascribed to water vapor and carbon dioxide in the earth's atmosphere mask the real solar spectrum (*7*). Familiar as the solar spectrum may appear, the infrared today challenges not only the astrophyhicist but also the laboratory spectroscopist. It has already stimulated the much-needed investigation of atomic spectra in this region.

Ultraviolet region. In the short-wave region Babcock has observed the spectrum with high dispersion between 2950 A and 3050 A (*8*), thus overlapping the region where Rowland's observations ended. Nature has provided a barrier to observations of shorter waves. Ozone in the earth's atmosphere absorbs the solar energy of shorter wavelengths. Here is an astrophysical problem that has fallen into the lap of the research worker who is interested in guided missiles. About 6 years ago, Tousey and his coworkers at the Naval Research Laboratory, and Hopfield with his associates at the Applied Physics Laboratory (*9*), first succeeded in directing sunlight to a grating spectrograph mounted in a rocket in flight above the ozone layer of the earth's atmosphere. This amazing accomplishment has carried the solar spectrum observations to 2300 A in the ultraviolet. With this equipment the dispersion is not high, but Tousey reports a resolution of 0.6 A for wavelengths greater than 2630 A (*10*).

In spite of serious blending, some salient features can readily be detected on the rocket spectrograms, the most notable ones being the tremendous pair of Mg II lines with emission cores (analogs of the Fraunhofer "H" and "K" lines of Ca II), one strong Mg I line, and one intense Si I line. Furthermore, by means of photon counters and a thermoluminescent phosphor, flown in rockets, Lyman α of H at 1216 A has been detected and is reported by Tousey to be the only important radiation within the response band of the counter. Pietenpol, Rense, Walz, Stacey, and Jackson at the University of Colorado have obtained a spectrogram showing this line, by using a grazing-incidence spectrograph pointed directly at the sun during a 28-sec exposure by a biaxial sun-follower in an Aerobee rocket, at an altitude that exceeded 80 km (*11*). Friedman and his associates have since reported that the line exhibits a narrow emission center about 1 A wide (*12*).

The over-all range of solar spectrum observations, exclusive of Lyman α of H at 1216 A, is from about 1850 A (*13*) to 24,000 A (2.4 μ). No student of cosmic abundances can overlook such an impressive array of spectroscopic material from our nearest star. In the region photographed with high dispersion (2950 A to 13,495 A), 26,000 lines of various intensities have been recorded, of which about 70 percent are wholly or partially identified.

Mention has been made of the two photometric atlases of the infrared section longer than 8462 A. In addition, Minnaert, Mulders, and Houtgast at Utrecht

[1] Address of the Retiring Vice President of Section D (Astronomy) of American Association for the Advancement of Science, at the Annual Meeting, Dec., 1953, in Boston, Mass.

(*14*) have prepared a magnificent photometric solar atlas from spectrograms made at the Mount Wilson Observatory. This extends from 3332 A to 8771 A. The solar spectrum as observed today provides, therefore, a wealth of material with which to refine and extend our knowledge of chemical elements in the sun.

Identifications

Generally speaking, abundance determination resolves itself into three steps. First, the solar lines must be accurately identified. The solar spectrum is produced by a mixture of chemical elements whose atoms are in various degrees of excitation and ionization in the solar atmosphere. Only by careful comparison of the measured positions and relative intensities of solar lines with individual laboratory spectra, can identifications be definitively assigned. Since line intensities depend on the numbers of active atoms engaged in the production of individual lines, measured solar intensities of all lines of a given spectrum, say Fe I, identified in the sun, will provide an estimate of the relative abundance of Fe atoms in the sun, provided that the laboratory excitation potentials of the individual lines are known. This principle forms the basis for the curve-of-growth method now used for abundance work —that is, the determination of the number of atoms engaged in the production of a solar line of given intensity.

This leads directly to the analyses of laboratory spectra and the selection of the laboratory lines of a given spectrum likely to be present in the sun, provided that the presence of the element in question is not obvious. For some spectra, a line-by-line comparison of laboratory and solar lines with regard to position and relative intensity leaves no doubt that the element is present and fairly abundant. Practically every laboratory line of neutral iron, for example, has its counterpart in the solar spectrum. For other elements, such as silver, only the leading lines are present. This suggests immediately that, in the sun, iron atoms are more abundant than those of silver.

Since obvious identifications among the solar lines have already been made in pushing this frontier forward, care must be exercised to search for the lines to be expected in the more dubious cases and to avoid spurious accidental coincidences. The selection of "likely lines" should be made from a study of the known multiplets of a given spectrum, which in turn are worked out on the well-known principles of the quantum theory. Lines of a given multiplet are produced by transitions between the energy levels that comprise each of two spectroscopic terms, one term belonging to the "even" set and the other to the "odd" set. The excitation energy of a given line, required in the ionization formula for abundance determination, is obtained directly from the value of the lower energy level involved in the production of a given line. Hence, the multiplets provide both factors needed—that is, the groups of related lines and the excitation potentials of the separate lines.

When the ultimate lines, or *raies ultimes*, of a given spectrum occur in the well-observed range of solar observations—that is, not the ultraviolet region observed only from rockets—the search is easy. Meggers has compiled the *raies ultimes* of first and second spectra (*15*). A selected list of those in the rocket region is given in Tables 1 and 2.

For first spectra (Table 1), a limited number of special interest for future solar work are listed. The Balmer line Hα at 6562.808 A dominates the solar spectrum as far as intensity is concerned, in spite of the fact that the low excitation potential of this line is 10.15 electron-volts (ev). This in itself indicates the overwhelming abundance of hydrogen in the sun's atmosphere. No wonder then, that Lyman α, the H line at 1215.668 A (E P 0.00) has atracted the attention of rocket observers of the solar spectrum. It should more than justify the statement of these observers that "much of the radiation is concentrated in this one line."

Table 1. *Raies ultimes* of selected first spectra.

Z	Sp	λ(A)	Z	Sp	λ(A)
1	H I	1215.668	30	Zn I	2138.56
4	Be I	2348.612	32	Ge I	2651.184
5	B I	2497.724	33	As I	1890.42
6	C I	1656.998	48	Cd I	2288.02
7	N I	1134.979	76	Os I	2909.06
8	O I	1302.174	77	Ir I	2543.97
9	F I	954.825	78	Pt I	2659.44
12	Mg I	2852.120	79	Au I	2427.95
14	Si I	2516.109			
15	P I	1774.942			
16	S I	1807.31			

Three Be I lines at 3321 A are unquestionably present, although they are faint in the solar spectrum. The *raie ultime* should be easily identifiable in a high-dispersion ultraviolet solar spectrogram. Similarly, the ultimate lines of B I should be present. So far, the only evidence of boron in the sun is in the identification of molecular lines due to BH. Fluorine is also detected only in compounds; the *raie ultime* of F I is at 954 A, where solar spectrum observation is more difficult. Lines of the first spectra of carbon, nitrogen, oxygen, silicon, phosphorus, and sulfur are all represented in the long-wave region of the solar spectrum, in spite of high excitation potentials. Except for N I, the solar lines are fairly strong, and Si I multiplets are conspicuous. Consequently, the ultimate lines should be even stronger, but they lie in the solar wavelength region as yet incompletely explored. On the blended rocket spectra, the Si I multiplet whose leading line is at 2516.109 A is undoubtedly an important contributor to the observed features, and the strong Si I line at 2881 A can be unquestionably identified. The *raie ultime* of Mg I is a conspicuous winged line in rocket spectra, and its intensity is consistent with that of the strong Mg I lines of greater wavelength.

The lines in the second group ($Z = 30 \ldots 79$) in Table 1 will, in general, be weaker, but the *raie ultime*

of Zn I should be fairly strong in the sun. Two Zn I lines having an E P of 4 ev give rise to solar lines of intensity 3 on the Rowland scale. The entire multiplet is present, the lines are unblended, and further evidence of Zn I in the sun is afforded by other multiplets. Germanium, osmium, iridium, and platinum have been identified in the sun, but ultraviolet solar observations would be useful in providing additional confirmation. Blending affects some of the present identifications, and the solar lines are not numerous, for these spectra. The accessible lines of As I cannot be identified in the sun because of serious blending or masking, and they are not the leading lines in the spectrum. It might be interesting to search for the stronger low-level lines at 2288 A and 2349 A, since the *raie ultime* is more inaccessible. One line each of Cd I and Au I has been detected in the visible solar region, and more lines might well be expected in the short-wave region.

The *raies ultimes* of selected second spectra—that is, those of special future solar interest—are in Table 2. It was long anticipated that the ultimate lines of Mg II would be the dominating features of the ultraviolet solar spectrum, and the rocket spectrograms confirm this abundantly. The two lines 2795 A and 2802 A are tremendous winged lines with emission cores, as one would expect for the analogs of the Fraunhofer "K" and "H" lines of Ca II, 3933 A and 3968 A. As Tousey remarks (*10*), "These emission lines have been obtained on all flights and in approximately the same relative intensity." The spectra Cr II through Ni II, whose *raies ultimes* are listed in Table 2, will furnish an interesting array of identifications and account for many features if and when the rocket region can be studied in more detail. As it is, Fe I and Fe II lines are so predominant that other weaker contributors struggle for detection. In the right-hand side of Table 2, the spectra of Mo II, Ru II, and Rh II are represented by faint lines in the accessible solar region. Further identifications in this group, of lines to shorter waves, would provide a good supplement to the existing very faint solar lines of these spectra. A search should also be made for Pd II and Ag II in the short-wave region.

TABLE 2. *Raies ultimes* of selected second spectra.

Z	Sp	λ(A)	Z	Sp	λ(A)
12	Mg II	2795.523	42	Mo II	2816.154
24	Cr II	2835.63	43	Tc II	2543.24
25	Mn II	2576.107	44	Ru II	2403.72
26	Fe II	2382.034	45	Rh II	2334.77
27	Co II	2286.165	46	Pd II	2296.53
28	Ni II	2216.479	47	Ag II	2246.43

Tc II ($Z=43$) is in a class by itself. The laboratory study of the structure of this spectrum was made from an artificially produced sample (*16*). A search for the multiplet whose lines are at 2543 A, 2610 A and 2647 A in a high-dispersion solar spectrum might settle the interesting question regarding the presence or absence of this element in the sun. So far as I am aware, the only evidence of Tc in nature is furnished by the identification of the leading low-level lines of Te I in S-stars, as reported by P. W. Merrill (*17*).

In spite of its brevity, the foregoing resume of leading identifications of special interest to be anticipated from future observations of the ultraviolet solar spectrum may furnish a starting point for further work on atoms and ions in the sun. So far, no third spectra have been detected; but, in many cases, for these the ultimate lines extend far into the ultraviolet, and the possibility of their presence is not ruled out.

PREDICTED LINES

Aside from the future extension of solar identifications into the ultraviolet, much can be done with existing multiplet material on extending the identifications in the range between 2950 A and 2.4 μ (24,000 A).

Reference has already been made to the importance of multiplet interpretation in the correct assignment of solar lines to their atomic origin. In a well-analyzed complex spectrum of atoms or ions known to be present in the sun, multiplets are known whose leading lines are found in the laboratory but whose satellite lines are missing. Predicted positions of the missing lines can be calculated from the energy levels in accordance with the quantum rules. Search for the predicted lines in the sun has been most successful in extending the identifications.

The Fe I spectrum is especially well suited to this type of study, since the sun proves to be a better source for faint Fe I lines than our present laboratory sources. To date, there are 4860 classified Fe I lines arising from combinations among 464 energy levels. All but 19 of these have been grouped into 146 terms, which combine to give 1342 multiplets (*18*). Before this analysis was published, all multiplets having lines in the accessible solar region were carefully examined for "predicted" lines in the sun. The lines were graded "good" or "fair" according to the intensity behavior of observed laboratory lines of the multiplets in solar and spot spectra, according to the agreement of predicted and solar wavelength, and according to the likelihood of the line being present in the sun with regard to its position in the multiplet. In this way, 1254 predicted Fe I lines of the a forementioned 4860 were classified from the solar wavelengths, because laboratory data were lacking on these fainter lines of Fe I.

An example illustrates the method. Theoretically, the multiplet $a\ ^5F - z\ ^7D^\circ$ should give rise to 13 "permitted" lines, that is, lines permitted by the quantum rules—an even to odd transition with each low level of inner quantum number J, combining with each level of the higher term having the same J-value or a value different by ±1. Only three lines of this multiplet have been observed in the laboratory, those marked "Lab" in the multiplet array presented in Table 3. The energy levels of the low term, $a\ ^5F$, are given at the top with the intervals in parentheses; on the left, the levels of $z\ ^7D^\circ$ are entered. The Fe I lines of this group are produced by permitted transitions from the $a\ ^5F$ levels

TABLE 3. Fe I multiplet–predicted lines.

	$3d^7(a\,^4F)4s$	$a\,^5F_5$ 6928.280	(448.495)	$a\,^5F_4$ 7376.775	(351.296)	$a\,^5F_3$ 7728.071	(257.724)	$a\,^5F_2$ 7985.795	(168.930)	$a\,^5F_1$ 8154.725
$3d^6\,4s(a\,^6D)4p$										
$z\,^7D_5°$ 19,350.894		Lab (15) 12,422.65 2.614	(448.49)	Sun 11,974.16 4.119						
$z\,^7D_4°$ 19,562.457		Lab (6) 12,634.18 4.177	(448.48)	Sun 12,185.70 5.682	(351.38)	Sun 11,834.32 4.386				
$z\,^7D_3°$ 19,757.040				Lab (4) 12,380.30 0.265		Absent 1202 8.969		Absent 1177 1.245		
$z\,^7D_2°$ 19,912.511						Sun 12,184.42 4.440	(257.68)	Sun 11,926.74 6.716		Absent 1175 7.786
$z\,^7D_1°$ 20,019.648								Sun 12,033.86 3.853	(168.93)	Sun 11,864.92 4.923

Laboratory						Sun				
Grade	A	K	Intensity	J	Designation	A	K	Intensity Disk	Intensity Spot	Δλ Sun-Lab.	Identification
	8047.60	12,422.65	15	5–5	$a\,^5F - z\,^7D°$	8047.625		4	8	+0.02	Fe I
Good	8204.10	12,185.68	predicted	4–4		8204.09	12,185.70	−2	1	−0.01	Fe I p
	8310.98	12,028.97	"	3–3		Absent					
Good	8382.23	11,926.72	"	2–2		8382.217	11,926.74	−3		−0.01	Fe I p
Good	8425.89	11,864.92	"	1–1		8425.889	11,864.92	−3		0.00	Fe I p
	7912.866	12,634.18	6	5–4		7912.870		2	5	+0.004	Fe I
	8075.13	12,380.30	4	4–3		8075.158		2	6	+0.03	Fe I
Good	8204.93	12,184.44	predicted	3–2		8204.95	12,184.42	0N	5*	+0.02	Fe I p
Fair	8307.61	12,033.85	"	2–1		8307.603	12,033.86	0	2*	−0.01	Atm. Fe I p
Good	8349.05	11,974.12	"	4–5		8349.02	11,974.16		3	−0.03	Fe I p
Good	8447.63	11,834.39	"	3–4		8447.678	11,834.32	−3	−1	+0.05	Fe I p
	8492.95	11,771.24	"	2–3		Absent					
	8502.66	11,757.79	"	1–2		Absent					

* Blend.

to the $z\,^7D^\circ$ levels. Thus, the leading line is observed at 8047.60 A, has the wave number 12,422.65 K, and represents the transition $a\,^5F_5 - z\,^7D_5^\circ$. The calculated wave number is the difference between the two energy levels 6928.280 K and 19,350.894 K, which equals 12,422.614 K. Conversely, calculated wave numbers and the corresponding wavelengths can be worked out for the whole multiplet, as has been done in Table 3. In the lower half of the table, these data are listed in different form, with laboratory material on the left-hand side and the relevant solar data on the right-hand side. A conclusive check on the presence of the predicted lines in the sun is provided by testing the intervals when solar wave numbers from the column headed "K" below are put in the multiplet array above. The agreement is excellent:

Laboratory	*Sun*
448.495	{448.49 {448.48
351.296	351.38
257.724	257.68
168.930	168.93

The two values of the interval 448 represent differences between laboratory and solar wave numbers, respectively, but the others are entirely solar; that is, they are from the solar wave numbers of lines whose wavelengths in the solar spectrum agree with those predicted from the multiplet relationships. The agreement within this multiplet is so good and the lack of blending in the solar spectrum is so satisfactory that the grading of the predicted lines is "good" except for the one predicted line that is a blend of a solar line and a line present in the spectrum of the earth's atmosphere. This predicted line is graded "fair."

The existence in the sun's atmosphere of more than 1250 such Fe I lines identified by prediction but not observed in the laboratory has stimulated the search for laboratory sources that will excite faint Fe I lines. In 1950, Kiess (*19*) reported at a meeting of the American Astronomical Society that he had measured about 28 percent of the predicted lines in each of two regions, 6600 A to 8680 A and 3600 A to 4300 A. The faint lines were detected on a long exposure made with iron electrodes used in an electric arc. Since then he has extended these observations to cover the range 2980 A to 8680 A, except for a short span from 6000 A to 6600 A where numerous molecular lines appearing on his spectrograms mask the Fe I lines.

A summary of Kiess' results to date is given in Table 4. Counts of the number of predicted lines graded "good" or "fair" are listed by intensity. Here the Rowland visual estimates for lines of intensity 1 and greater, 0, −1, −2, −3, have been used, −3 meaning 0000 or the faintest trace recorded in Rowland's list. Under the heading "P" the counts of predicted lines are given for each grade, good and fair; under "O," the counts of these predicted lines that have been measured by Kiess in the laboratory on one long exposure of the Fe I spectrum, excited, as before, by an electric arc. Of a total of 1114 lines, he has found 329, or 30 percent. As is to be expected, the percentage decreases as the lines become fainter. This source is not ideal, because the stronger Fe I lines are seriously overexposed and mask fainter lines. The problems of observing them with higher resolution and of developing a more suitable source, such as an electrodeless discharge, immediately present themselves. The conclusive test of the reality of the laboratory lines is that they should appear on more than one exposure. So far this has been done for only one short region, as is shown in the lower half of Table 4. Of 131 predicted lines between 4253 A and 4634 A, Kiess has observed 24, or 18 percent, on each of two exposures unequal in quality. This work is in progress, and the present results look extremely promising. They stress the incompleteness of observational data in what is commonly considered a well-known but complex laboratory spectrum.

The method outlined for identifying Fe I lines in the sun by prediction has proved very successful in pushing further the general frontier with regard to atomic lines in the sun. For some spectra of other

TABLE 4. Total counts of predicted Fe I solar lines observed in laboratory (summary).

Intensity	1 and >		0		−1		−2		−3		Total	
Grade			λλ2980–6000;		λλ6600–8680							
	P O	%	P O	%	P O	%	P O	%	P O	%	P O	%
Good	114(58)	51	84(39)	46	96(39)	41	75(20)	27	71 (2)	3	440(158)	36
Fair	97(37)	38	108(37)	34	171(57)	33	158(31)	20	140 (9)	6	674(171)	25
Total	211(95)	45	192(76)	40	267(96)	36	233(51)	22	211(11)	5	1114(329)	30
Counts of lines observed on two spectrograms of Fe I λλ4253–4634												
	P O		P O		P O		P O		P O		P O	%
Good	5 (1)		6 (3)		6 (1)		4 (0)		———		21 (5)	24
Fair	13 (4)		26 (6)		53 (8)		17 (1)		1 (0)		110 (19)	17
Total	18 (5)		32 (9)		59 (9)		21 (1)		1 (0)		131(24)	18

elements, the lines appear wide and very diffuse when observed in the laboratory with an arc in air as source. Although the laboratory lines are well known, their wavelengths are inaccurate. Here again the solar wavelengths are preferable, and solar wave numbers in the multiplets are beautifully consistent. When well-known features of a spectrum have been identified in the sun, it is also often possible to find additional faint members of multiplets by the method of prediction just outlined.

C I and Mg I are illustrations of particular interest. Glad, in Sweden, has extended the laboratory observations of C I; and, as a result, Edlén has succeeded in predicting a singlet combination $3p\ ^1P_1$ to $3d\ ^1P_1^\circ$ at 10,123.90 A (20). The nearest solar line is at 10,123.895 A, and there can be no doubt that this line is due to C I. This has been the strongest solar line that has defied identification, and now Edlén has attributed it to atoms well known in the solar atmosphere. Some 20 fainter solar lines have also been identified as due wholly or partially to C I, as a result of this recent work. Many other fine illustrations could be cited.

Laboratory observations in the infrared with suitable receivers offer great hopes to the astrophysicist. R. A. Fisher and Miss Eshbach at Northwestern University have recently published new measurements of Mg I (*21*); they have observed 10 lines between 11,828 A and 17,108 A by using arc and hollow cathode sources. It has been anticipated that these would be important solar lines, but precise laboratory measurements of wavelength have not been available. The line at 14,877.50 A, head of the $3d\ ^3D - nf\ ^3F^\circ$ series, is a conspicuous line in the Michigan Infrared Solar Atlas, as is also the group at 15,024 A to 15,047 A, $4s\ ^3S - 4p\ ^3P^\circ$. Furthermore, Mohler (*22*), has observed solar Mg I at 33,961 A (3.4 μ) $3d\ ^1D_2 - 4p\ ^1P_1^\circ$. In fact, both Mg I and Si I are strikingly represented by strong solar lines ranging from 0.28 μ to 3.4 μ.

Humphreys' recent laboratory observations of the sixth series in the spectrum of atomic hydrogen (*23*) are also of special interest astrophysically.

Mention has already been made of the strength of the Fraunhofer "H" and "K" lines of Ca II in the solar spectrum. Numerous other Ca II lines are also present. Although this spectrum is regarded as well known, it is only recently that important data have been found from laboratory observations in the infrared region. Risberg (*20*), in Edlén's laboratory, has observed Ca II with a hollow cathode source and reported four new multiplets. Edlén has recently identified 11 additional Ca II lines between 8202 A and 21,429 A in the sun from these data, two of which are based on prediction as described in a foregoing paragraph for Fe I.

Similarly, Humphreys (*24*) has succeeded in observing the Ca I spectrum between 12,816 A and 22,655 A, thus accounting for more lines found in the Michigan Solar Atlas. This work is of special interest from the standpoint of spectral structure, because it establishes the position of a ^3F term of the $3d^2$ configuration—a term predicted by theory but not previously located, because infrared observations were lacking.

So this solar panorama spreads before us—an old and well-known subject still challenging us to carry on and untangle the mysteries of the origin of the thousands of lines in its spectrum. In connection with the preparation of tables on "Atomic Energy Levels," a program now in progress in the Spectroscopy Section of the National Bureau of Standards, the multiplet material collected for the compilation is being used also to revise and extend the solar identifications of atomic lines. However, this second revision of Rowland's table is more significant because of revised intensities than because of the revised identifications. Heretofore, the lines have been assigned visual estimates of intensity on a scale starting with the faintest trace as – 3, or 0000, and going to 1000 for Ca II (K). A better measure of intensity is needed for accurate abundance work. For the new edition, Minnaert and his collaborators at Utrecht are providing these measured intensities—that is, carefully calibrated equivalent widths of the lines that appear on the splendid Utrecht Solar Atlas (*25*). When complete, the astrophysicist will have a veritable mine from which to dig out the "cosmic materials."

So far, this article has outlined only general methods of extending our knowledge of the sun through further study of its spectrum. Only a selected few of the many kinds of atoms and ions present have been mentioned for illustration. The atoms and ions detected in the sun's atmosphere can, however, be briefly summarized (Table 5).

This picture is a consistent one, all told. Most of the elements not found can be explained by a high ionization potential or by a high excitation potential of the accessible lines. For six neutral spectra, Cs I, Re I, Tl I, Bi I, Ra I and V I, the ultimate lines are in a favorable region and are not detected.

The rare earths are represented mostly by second spectra, because of the relatively low first ionization potentials. Those whose first spectra are concentrated in a very few strong lines, Eu I and Yb I, have their leading lines present in the spectrum of the spot where the lower temperature causes less ionization. Radioactive elements are not detected in general. The total number of elements found to date is 67, of which three are questionably identified, and one, argon, is represented only as a forbidden line [A x] in the corona. First spectra of 53 elements and second spectra of 36 elements are represented by lines in the solar spectrum, 25 elements having both first and second spectra represented. The laboratory data are insufficient to test the presence of the two rare earths promethium and holmium.

Two elements, B and F, are found only in compounds; 18 compounds are known to be present in the solar or spot spectrum (*26*). This is an enormous and interesting subject in itself—one that has as yet been very incompletely studied in solar and spot spectra.

TABLE 5. Atoms and ions in the sun.

Z	Spectrum		Z	Spectrum		Z	Spectrum	
	I	II		I	II		I	II
1	H I		26	Fe I	Fe II	56	Ba I**	Ba II
2	He §	He II§	27	Co I	Co II	57	La I	La II
3	Li I*		28	Ni I	Ni II	58		Ce II
4	Be I	Be II	29	Cu I	††	59		Pr II
5	(B)‡		30	Zn I	†	60		Nd II
6	C I	†	31	Ga I		62		Sm II
7	N I	†	32	Ge I		63	Eu I*	Eu II
8	O I	†	37	Rb I*		64		Gd II
9	(F)‡		38	Sr I	Sr II	65		Tb II?
11	Na I	††	39	Y I	Y II	66		Dy II
12	Mg I	Mg II	40	Zr I	Zr II	68		Er II?
13	Al I	††	41	Cb I	Cb II	69		Tm II
14	Si I	Si II	42	Mo I	Mo II	70	Yb I*	Yb II
15	P I	†	44	Ru I	Ru II	71		Lu II
16	S I	†	45	Rh I	Rh II	72	Hf I	Hf II
19	K I	††	46	Pd I		73	Ta I?	
20	Ca I	Ca II	47	Ag I		74	W I	
21	Sc I	Sc II	48	Cd I**		76	Os I	
22	Ti I	Ti II	49	In I*		77	Ir I	
23	V I	V II	50	Sn I		78	Pt I	
24	Cr I	Cr II	51	Sb I		79	Au I**	
25	Mn I	Mn II				82	Pb I	
						90		Th II**

§ He I strong in chromosphere.
‡ Detected only in compounds: B, F (BH, MgF, SrF).
† High first IP and high EP of accessible lines of second spectrum unfavorable.
†† High EP of accessible lines of second spectrum unfavorable.
* Evidence depends on strength of lines in spot spectrum.
** Represented in sun by one line only (RU in case of Ba I and of Th II); [A x] in corona furnishes only evidence of A in sun.

Doubtless many of the fainter solar lines as yet unidentified will prove to be of molecular origin. Only about 70 percent of the 26,000 lines in the photographic range 2950 A to 13,495 A have today been wholly or partially identified; so our task is well begun but not done.

With respect to elements in the sun, a brief summary of abundances may be of interest. No one can doubt the great preponderance of H and the lighter elements as constituents of the sun. Struve quotes the following figures for these elements: by weight H 70 percent, He 28 percent, O group 1.4 percent, metals 0.4 percent (*27*). Present calculations from data on equivalent widths of solar lines indicate that the earlier values found by Russell from the estimated Rowland intensities are remarkably good. As a practical illustration of abundance as related to line intensity, Russell states that the platinum line at 3064.695 A, having Rowland intensity 1, indicates the existence of some 500 million tons of the metal in the reversing layer. "This is of course very small compared with the whole mass of the reversing layer, which . . . probably exceeds 10^{15} tons" (*28*).

Granting the over-all abundance of the lighter elements, it is interesting to compare the relative amounts of various heavier elements in the sun and in meteorites. The most complete and concise presentation known to me is that by Harrison Brown (*29*). Here solar abundances are plotted against meteoritic abundances, starting by setting solar Ca equal to meteoritic Ca. The lengths of the lines designate the estimates of the limits of error. When this article appeared, Russell pointed out the one apparent discrepancy, namely, zinc. I am prompted to defend the solar data; the identifications appear to be entirely correct. Perhaps a more extensive search for this element in meteorites should be made. The marvel of it all, however, is the consistency in the general picture of cosmic abundances.

The book is not closed. As future years unroll, our studies of the solar spectrum promise to be fascinating. Some particular problems deserve special mention.

1) A high-dispersion spectrogram in the far ultraviolet would be rich in lines of first and second spectra of abundant elements whose *raies ultimes* are at present inaccessible. One might possibly foresee some third spectra represented.

2) Our knowledge of rare-earth spectra should be greatly extended. Laboratory analyses of these spectra, so rich in lines, will fulfill the astronomer's dream

and enable him to tag many more other stellar, as well as solar, lines. Third spectra of these elements are urgently needed.

3) In the infrared, the leading series members whose lines are approximately known need to be observed with the proper heat detectors. To quote Edlén (*20*), "While existing laboratory data on atomic spectra seem to permit a fairly exhaustive identification of the solar spectrum lines in the visible and near ultraviolet, the situation is far less satisfactory in the infrared, even in the region which is photographically accessible."

4) In both the ultraviolet and the infrared, the problem of extending standards of wavelength presents itself. So far, in the near infrared, the identification of lines by prediction from the known energy levels has provided beautiful confirmation of the internal consistency of the wavelength scale of the solar spectrum (*30, 31*).

5) The whole subject of molecules in the sun needs serious attention and entails a great extension of laboratory study of those band spectra of the more abundant elements.

6) The wealth of material soon to become available on measured intensities of solar lines can be used to great advantage in improving the present identifications as well as the solar curve of growth.

7) Only casual reference has been made to the sunspot spectrum—a spectrum consisting of thousands of lines that have as yet not even been measured. The general features are known, but a spot spectrum photographed with the same spot over the whole spectral range has yet to be made. Here nature has provided another cosmic laboratory that invites thorough study.

8) No discussion of the observation of solar x-rays has been included, although these have been observed from 5 A to 7 A (*10*). One can hardly guess the far-reaching consequences of work in this field and its bearing on ionospheric research.

It is hoped that the present comments, inadequate as they are to do justice to this enormous subject, emphasize at least in part the potentialities offered by the solar spectrum as a stepping stone in the larger study of the universe and its constituents.

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News and Notes

International Geophysical Year Program

A major international geophysical research program, involving cooperation among more than 28 nations, is currently being planned for 1957 and 1958. The United States program, being prepared by a national committee appointed by the National Academy of Sciences–National Research Council, envisions a series of intensive observations and measurements in the principal fields of geophysics.

The compelling reason for a world-wide program in geophysics is the global nature of geophysical phenomena. Many of the major problems in geophysics require the simultaneous observation of phenomena in many parts of the world, and this need for synoptic data constitutes the fundamental criterion in the determination of the IGY program.

The importance of geophysical data in synoptic form, representative of a large region, was recognized in the last century in the conduct of the First Polar Year in 1882–83, when meteorological, magnetic, and auroral stations were established in the Arctic regions. This early exploration of geophysical phenomena produced significant results: in particular, it led to a considerable clarification of knowledge of geomagnetism and to the first orderly representation by Fritz of the geographic location of the auroral regions.

A second international Polar Year was held in 1932–33, 50 yr later, and ionospheric observations were included in the program. Perhaps the most important contribution of this endeavor was the knowledge of the ionosphere, obtained by utilizing the radio sounding techniques developed by Breit and Tuve a few years before, which greatly advanced the science of radio communications.

The proposed international effort for 1957–58 surpasses in scope, intensity, and geographic coverage these earlier efforts, which were largely limited to the north polar regions. Areas throughout the world will be included in the program—the Arctic and Antarctic regions as well as the major land and sea masses of the earth. In keeping with the increased activity and interest in geophysics, the magnitude of effort to be devoted to each of the fields under study will be appreciably greater, and the number of fields, in contrast to the three or four in the past, will be ten: solar activity, longitude and latitude determinations, glaciology, oceanography, meteorology, geomagnetism, aurora and airglow, ionospheric physics, cosmic rays, and upper atmosphere rocket studies.

The proposal that 1957–58 be the time for this major international effort was based in part upon the fact that this period corresponds with a period of maximum solar activity. It was based in part also upon the fact that advances in various fields of science, including instrumentation, suggest that significant advances might well be achieved through a properly integrated international activity. More than 28 nations have already indicated that they intend to participate, and American scientists, under the sponsorship of the National Academy of Sciences–National Research Council, have prepared a tentative program for the United States.

International coordination of the program is under the direction of the Special Committee for the International Geophysical Year established by the International Council of Scientific Unions. Sydney Chapman of Great Britain is chairman of this committee, L. V. Berkner of the United States is vice chairman, and M. Nicolet of Belgium is secretary general. The U.S. National Committee for the IGY, charged with responsibility for the preparation of the American program, was established, in response to a request from ICSU, by the National Academy of Sciences–National Research Council, which is the adhering body of the United States to ICSU and the various scientific unions. The membership of the U.S. National Committee includes: chairman, Joseph Kaplan, University of California; vice chairman, A. H. Shapley, National Bureau of Standards; recording secretary, N. C. Gerson, Air Force Cambridge Research Center; and L. H. Adams, H. G. Booker, Lyman J. Briggs, G. M. Clemence, C. T. Elvey, J. A. Fleming, L. M. Gould, F. W. Reichelderfer, E. B. Roberts, P. A. Siple, A. F. Spilhaus, M. A. Tuve, and A. L. Washburn. Ex-officio members are W. W. Atwood, Jr., L. V. Berkner, and William W. Rubey. H. K. Stephenson has been designated liaison representative to the Committee by the National Science Foundation. The National Academy of Sciences has appointed Hugh Odishaw, former assistant to the director of the National Bureau of Standards, as administrative secretary of the Committee.

The preparation of the U.S. program has been assigned by the U.S. National Committee to a coordinating group of reporters, each responsible for a particular aspect of the program: *world days*, A. H. Shapley, National Bureau of Standards; *meteorology*, Harry Wexler, Weather Bureau; *geomagnetism*, E. B. Roberts, Coast and Geodetic Survey; *aurora and airglow*, C. T. Elvey, Geophysical Institute, Alaska; *cosmic rays*, S. A. Korff, New York University; *solar activity*, S. B. Nicholson, Mount Wilson Observatory; *ionospheric physics*, H. G. Booker, Cornell University; *longitude and latitude*, G. M. Clemence, Naval Observatory; *glaciology*, W. O. Field, American Geographical Society; *oceanography*, E. H. Smith, Woods Hole Oceanographic Institution; and *rocketry*, J. A. Van Allen, Princeton University. The reporters are being aided in these preparations by a broad representation of scientists in fields appropriate to IGY. The Committee invites suggestions and participation by scientists of the nation. Communications may be addressed to the U.S. National Committee, International Geophysical Year, National Academy of Sciences, 2101 Constitution Ave. NW, Washington 25, D.C.

Annual Meeting of the AAPT

THE 23rd annual meeting of the American Association of Physics Teachers was held at Columbia University, Jan. 28–30, concurrently with the annual meeting of the American Physical Society. The combined meeting exhibited the property of induced radioactivity: just as the attempt to combine an excessive number of particles in a single nucleus results in the expulsion of one of them, so the attempt to place too many sessions on the Columbia campus caused one session to be expelled. In this case, it was the Friday morning AAPT session, which came to rest on the campus of the City College of New York.

The excited state of Columbia, owing to the bicentennial celebration going on, brought an untraditional aspect to this meeting; not one of the AAPT sessions could be held in a regular physics lecture room. It has already been announced that Columbia will not again be host to the APS meetings. This fact provides a vivid example of the growth of the sciences in the last 25 years. I recall my first visit to Columbia's campus, in 1928, when the University was able to be host to the entire AAAS. Now it cannot find space for a single major science.

The AAPT program was composed, in roughly equal parts, of short contributed papers, of panel discussions, and of invited papers. Prominent on the program, almost constituting a theme of the meeting, were audio-visual aids. On this subject, the Association has a continuing committee, which presented five new films recently made under its sponsorship by the McGraw-Hill Book Company. These covered such topics as wave motion and atomic energy. Also in line with the audio-visual theme was a 1-hour demonstration of the steps in the development of color television by a representative of RCA.

It is of interest that every scheduled talk, long or short, was recorded on tape. One purpose for this is to allow the smaller regional meetings to supplement their local programs with portions from the annual meeting.

The panel discussions were designed to explore some matters that are regarded as controversial. One subject for discussion was "The place of the physics department of engineering education." Another panel dealt with "Research subsidies and college teaching," with special reference to small colleges without present subsidized programs. Possibly most significant was a panel discussion that considered the present and future path of the Association itself and, in particular, of its organ, the *American Journal of Physics*.

One of the traditions of the joint annual meeting with the APS is a session at which the Association awards the Oersted medal, given this year to C. N. Wall, of the University of Minnesota, and listens to the annual Richtmyer Memorial lecture, in this instance delivered by John A. Wheeler, of Princeton University, on the subject, "Fields and particles."

The short contributed papers are the backbone of any AAPT program. Three that evoked considerable interest may be mentioned without prejudice against the others. One included the demonstration of a model of the scattering of alpha particles by thin foil; another was a report on college physics laboratory work in English universities; the other was a motion picture of the formation of tracks in a cloud chamber, which enables an entire class to observe the phenomenon simultaneously.

New officers for 1954 are president, Marsh White, Pennsylvania State University; president-elect, Ronald Palmer, Beloit College. The summer meeting will be held at the University of Minnesota, June 28–30.

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Science News

Alan T. Waterman, director of the National Science Foundation, has stated that the Executive Order signed by President Eisenhower on Mar. 17 [*Science* 119, 431 (Apr. 2, 1954)] will be valuable to the National Science Foundation and other federal agencies concerned with scientific research and development in that it defines their respective areas of individual responsibilities, as well as those which require cooperative action, and establishes certain mechanisms for implementing the National Science Foundation Act of 1950. Regarding the relative responsibilities of the Foundation and other Federal agencies in the support of basic research, Dr. Waterman pointed out that the order confirms the position taken earlier by the Foundation in its *Third Annual Report*. His statement follows:

> It has been the stated policy of the Executive branch of the Government to increase the responsibility of the National Science Foundation for Federal support of basic research. At the same time it is desirable for other agencies to support basic research closely related to the solution of problems for which they have statutory responsibility. . . .
>
> The effort to centralize support of basic research in the Foundation is desirable from the standpoint of logical administration of Federal research support, but it will clearly work against the best interests of science in the United States unless the Foundation together with the other research agencies can provide adequate support for basic research in order to balance support given to applied research and development. . . .
>
> The Foundation is in full accord with the view that other agencies should carry on basic research programs directly related to their operating functions. There are two principal factors in support of this position. First, there is the need of an operating agency for an assured and continuing direct flow of fundamental knowledge relating to its practical problems. Second, in view of the increasing dependence of these agencies upon scientific and technical developments, it is essential that the operating personnel maintain effective contact with the scientists of the country. Conversely, it is to the advantage of the country that scientists be encouraged to be interested in fields of great potential importance to national defense and welfare. Support of basic research in areas of immediate interest to the agency provides opportunity to maintain this two-way exchange on a healthy basis.

The order makes clear that in the area of developmental work each agency is expected to take responsibility for planning and conducting its own program in an effective and economical manner consistent with its operating mission.

Science has received from David W. Bailey, secretary to the Corporation of Harvard University, a communication which points out that the reproduction in *Science* of portions of a letter regarding administration of the **Arnold Arboretum** [*Science* **119**, 369 (Mar. 19, 1954)] "presents only one side of a controversy which for the past eight years has been the subject of conscientious, deliberate, and scholarly consideration and which has been brought to decision only after painstaking review and unanimous approval of both Harvard Corporation and Board of Overseers." Mr. Bailey asked that appropriate steps be taken to correct the partial and erroneous impression left with readers. *Science* gladly complies with this request for the presentation of both sides of the question. The succeeding excerpts are drawn from a lengthy and comprehensive statement, signed by the President and Fellows of Harvard University, that appeared in the *Harvard Alumni Bulletin* for Dec. 12, 1953.

We understand from Mr. Grenville Clark '03, a member of the Corporation from 1931 to 1950, that he has written a letter to the *Bulletin* setting forth his views on certain aspects of our administration of the Arnold Arboretum. We think that the alumni and other friends of Harvard are entitled . . . to know the history of the controversy over the Arboretum and our views on the questions involved. . . .

Early this year, Mr. Clark and a few others, acting through counsel, formally applied to the Attorney General of the Commonwealth of Massachusetts for permission to commence a proceeding in the name of the Attorney General to question our administration of the Arnold Arboretum, with particular reference to the validity of the removal of part of the library and herbarium of the Arboretum from Jamaica Plain to the new central building for botany in Cambridge. . . . After investigation, the Attorney General handed down an opinion, dated July 2, 1953, which closed with these words:

"There is not the remotest evidence here that Harvard has reached its decision in any manner other than honestly, faithfully and for what it considers to be the best interests of the Arboretum.

"There is no legal breach of trust. To permit the use of the name of the Attorney General in cases like the present, where it is clear to him the trustee is acting in good faith and within the bounds of reasonable judgment and sound discretion, simply because others, equally in good faith, differ with the decision of the trustee, would open the door to unreasonable and vexatious litigations. Accordingly, by direction of the Attorney General, the application is denied." . . .

On January 19, 1953, we adopted a resolution stating the policy of the Corporation regarding the administration of the Arnold Arboretum and the use of its endowment. The resolution provides for the removal of part of the Arboretum library and herbarium to the new central building in Cambridge which is being built entirely from unrestricted University funds. This move, by bringing together the principal collections in the University of research materials in botany, other than living collections, will greatly facilitate the work of scholars and students interested in the field in which the Arboretum carries on its important activities. A working collection of books and specimens will be retained at Jamaica Plain for use in connection with the living collections there. This decision has now become the principal issue in a controversy which had its beginning in 1945. The point at issue in no way involves the maintenance and continuation of the collections of living trees and shrubs of the Arboretum in Jamaica Plain. The primary issue now is whether certain books and dried specimens may be moved to Cambridge, or must be retained at Jamaica Plain.

Our resolution of last January was adopted more than seven years after the distribution among the Faculty, in June 1945, of Professor Irving W. Bailey's Plan for the coordination of activities in the field of botany and just seven years after the approval of the Plan the following January by the Department of Biology. It was adopted some two and one-half years after we had voted, in June 1950, to lay aside further consideration of the proposed central building so that the views of the Committee to Visit the Arnold Arboretum might be heard. . . .

Mr. Clark has criticized us for not having sought the instructions of a court as to our duty. We think that this criticism is wholly unjustified. We understand that as a matter of law instructions will be granted in Massachusetts only where the trustee has "real and serious doubts as to his duty." We have had no such doubts as to our duty in respect of the matters covered by our resolution of January 19, 1953. . . .

Mr. Clark has said that our position as one of the governing boards of the University as well as trustee of the Arboretum endowment prevents us from making a decision fair to the Arboretum on matters affecting both the University and the Arboretum. This seems to us manifestly unsound. When the trustees under the will of James Arnold selected the Corporation to carry out Arnold's broad charitable intent, they knew that the Corporation was already administering other endowment funds for closely related purposes in the fields of botany and horticulture. . . . We think it is clear that the donors of the Arboretum endowment intended that we should decide such questions as the question how the library and herbarium can best accomplish the purposes for which they were created.

Mr. Clark has also charged that we have acted improperly in defending before the Attorney General our decision to move part of the library and herbarium to Cambridge. . . . It was not our purpose, in putting the facts known to us before the Attorney General, to "shut off any judicial hearing whatever," as Mr. Clark has asserted. Our purpose was rather to make certain that the Attorney General, whose decision (as Mr. Clark recognized in applying to him) is necessary to a proceeding against the trustee, might have the benefit of hearing both sides of the controversy before exercising his discretion to take or decline to take that extreme step. We understand that the Assistant Attorney General made a most careful and thorough study of the question before reporting it to the Attorney General for final decision, . . . [and] in accordance with procedure established by law for just such a case as this, the impartial public officer entrusted by law with sole responsibility for such matters has determined that there is no breach of trust, and that we have acted in good faith and within the bounds of reasonable judgment and sound discretion.

The production and chemical identification of **element 100** has been reported by a group engaged in research for the Atomic Energy Commission in the University of California Radiation Laboratory. The work was reported by Bernard G. Harvey, Stanley G. Thompson, Albert Ghiorso and Gregory R. Choppin in the Mar. 1 issue of the *Physical Review*. However, the investigators state that owing to the existence of unpublished information on element 100 the question of its first preparation should not be prejudged on the basis of the present announcement.

The element was produced by a unique method of "fattening" up plutonium atoms with neutrons. In a two-stage process, a total of 15 neutrons was added to plutonium, which resulted in atoms of the element of atomic number 100 and mass number 254. The new element has no value for the production of nuclear weapons or nuclear power. It has a half-life of about 3 hr and decays by the emission of alpha particles of roughly 7.2 Mev. It is chemically analogous to erbium, element 68, a rare earth.

The most comprehensive study of a **solar eclipse** in history will take place on June 30 when scientists of the Air Force Cambridge Research Center and cooperating agencies study the first eclipse since 1947 spanning two continents. In a brief period of 2¾ hr, while the shadow of the moon races at 3000 mi/hr from Nebraska to Pakistan, experts will work at observation sites, some in extremely remote sections of the world. A year has been spent in making plans to view the eclipse because there will not be another total eclipse that spans North America and Europe until the year 2151. Three different methods of measuring long distances—Bonsdorff, Lindblad, and Gaviola—will be used. All are expected to give much more precise knowledge of the actual distance between points in the United States and Europe.

The eclipse path will start in Nebraska at sunrise, and proceed through eastern Canada, Labrador, southern Greenland, Iceland, the Faeroes and Shetland Islands, southern Norway and Sweden, Russia, Iran, Afghanistan, and Pakistan to its ending at sunset in northern India. Along this path will be four major sites and eight minor sites, the latter on the edges of the 80-mi wide shadow. American scientists will be responsible for observations at all places except the Scandinavian countries. In Norway and Sweden only a few U.S. observers will be present, and actual operations will be conducted by Finnish and Swedish scientists.

W. A. Heiskanen, director of Ohio State University's Institute of Geodesy, Photogrammetry and Cartography, will supervise the Bonsdorff and Lindblad methods. He will be assisted by T. J. Kukkamaki, Finnish geodesist, and J. Allen Hynek, professor of astronomy at the Ohio State University. Dr. Kukkamaki will be in charge of work at a position in Greenland, and Dr. Hynek will head the Ohio State party that goes to Iran. From Georgetown University, Francis J. Heyden, S.J., will conduct work with the Gaviola observations method, which he used on an eclipse expedition in Africa in 1952; in addition, he will have over-all charge of the eclipse station in Iran.

The three methods of observation will be employed simultaneously for the first time at four major sites: James Bay, Ont.; Knob Lake, Que.; the Okak Islands, off northeast Labrador; and Iran. The Bonsdorff method directly photographs crescents of the sun as the moon passes between it and the earth; the Lindblad method, also employing photography, shows the flash or reversed spectrum as the moon passes; the Gaviola method measures the decreasing light intensity as the moon shuts out the sun. It is felt that a true comparison of the relative accuracy of the three techniques will result from the June 30 studies.

A **supersonic hypodermic device** capable of penetrating 4 in. of tissue by hurling a tiny liquid column through the air at 1.75 times the speed of sound, has been developed by Benedict Cassen, Brian Dunne, Jr., and Herbert Gass at the Atomic Energy Project on the Los Angeles campus of the University of California. Liquid in a steel chamber is propelled through a 0.005-in. nozzle by the explosive action of a small wafer. The wafer is made from nitrosoguanidine, a heat-sensitive chemical, and is detonated by a small soldering iron in the device.

The most powerful particle accelerator yet built, the **University of California bevatron,** has gone into operation. The machine has accelerated protons to an energy of 5 Bev, the highest energy ever achieved by an accelerator. The $9,000,000 machine functioned successfully approximately 6 yr after its design first was conceived and 4 yr after construction began. It was built with AEC funds.

Recently President Eisenhower commended the **U.S. Geological Survey** for its scientific achievements and for the contributions it has made to the economic and cultural development of the nation. William E. Wrather, director of the Survey, accompanied by Secretary of the Interior Douglas McKay and Assistant Secretary Felix Wormser, was received at the White House by the President on the occasion of the Survey's beginning its 76th year.

Scientists in the News

Lyman Briggs, physicist and director emeritus of the National Bureau of Standards, has received the Merit Award of the American Society of Sanitary Engineering for "his contribution toward the advancement of sanitation" in directing the basic research on plumbing systems conducted by the Nationl Bureau of Standards.

William Brown, professor emeritus of plant pathology at the Imperial College of Science and Technology, University of London, is at present visiting

professor of plant pathology at Cornell University. He is teaching an advanced course on the physiology of parasitism in plants. Prof. Brown will return to Great Britain early in June. He will preside at the jubilee celebration of the Association of Applied Biologists in September.

The first faculty appointment for the new Albert Einstein College of Medicine in the Bronx, New York City, has been announced. **Leo M. Davidoff,** director of neurological surgery at Beth Israel Hospital (NYC) and neurosurgeon at Mount Sinai Hospital, has been named professor and chairman of the Department of Surgery at the college and director of surgery at the Bronx Municipal Hospital Center.

M. Edward Davis, a member of the University of Chicago Lying-in Hospital medical staff for the past 29 yr, has been named chief of staff. He succeeds **William J. Dieckmann,** chairman of the Department of Obstetrics and Gynecology. Dr. Dieckmann resigned his administrative post, which he has held for 12 yr, to devote full time to clinical activities and research as the Mary Campau Ryerson professor of obstetrics and gynecology.

Victor A. Drill, formerly professor of pharmacology at Wayne University of Medicine, has assumed the position of director of biological research for G. D. Searle & Co., Chicago.

Rolland F. Feldkamp, formerly director of basic research at the Smith-Dorsey Division of the Wander Company in Lincoln, Neb., has been appointed director of pharmaceutical development at Mead Johnson & Company in Evansville, Ind.

Victor M. Ganzer has been appointed executive officer of the Department of Aeronautical Engineering, University of Washington. He has been the acting head of the department during the past year following the resignation of **Fred Eastman** because of ill health.

Charles W. Goff, orthopedic surgeon of Hartford, Conn., has been appointed visiting professor of physical anthropology at the Hartford Seminary Foundation.

George T. Harrell, until recently research professor of medicine at the Bowman Gray School of Medicine, Wake Forest College, has assumed the duties of dean of the College of Medicine for the newly created University of Florida Health Center. A new building is soon to go up on the Florida campus, and the College of Medicine will be opened to the first 50 students in 1955.

Wm. Hugh Headlee, professor of parasitic diseases at the Indiana University School of Medicine and Medical Center, Indianapolis, is on leave of absence while he serves in Bangkok as medical parasitologist for the Foreign Operations Administration's Special Technical and Economic Mission to Thailand. Dr. Headlee's work is particularly concerned with the control of intestinal parasitic diseases, and with the teaching of parasitology in the two schools of medicine and the school of public health in Bangkok.

Peter King, formerly head of the High Polymer Branch of the Chemistry Division at the Naval Research Laboratory, Washington, D.C., has been named superintendent of the NRL Chemistry Division.

Tellis A. Martin, formerly with the Central Research Laboratories of General Analine and Film Corporation, has recently joined the Mead Johnson Research Laboratories, Evansville, Ind., as a senior research chemist in the Division of Organic Chemistry.

John Hugh Mulholland, George David Stewart professor of surgery in the College of Medicine of New York University-Bellevue Medical Center, has been appointed chairman, for a 3-yr period, of the Surgery Study Section of the Division of Research Grants of the National Institutes of Health, U.S. Public Health Service. Dr. Mulholland has been a member of the Section since Jan. 1, 1952. He is also chairman of the College of Medicine's Department of Surgery and chairman of the Cancer Institute of New York University-Bellevue Medical Center.

Herman R. Sweet, associate professor of biology at Tufts College, has been appointed assistant editor of the American Orchid Society's *Bulletin*.

Albert Szent-Gyorgyi, biochemist, director of the Institute for Muscle Research at Woods Hole, Mass., and 1937 Nobel Prize winner, has won the 1954 Albert Lasker Award of the American Heart Association. He received the $1000-prize for his "distinguished research achievements in the field of cardiovascular diseases which have led to new understanding of the basic physiology of the heart."

I. Barry Tarshis, formerly parasitologist for the Bureau of Animal Industry, U.S.D.A., at the Georgia Experiment Station, Experiment, Ga., has been made deputy chief, Transmission Section, Allied Sciences Division, Camp Detrick, Frederick, Md.

Oleg Yadoff, research professor at Manhattan College and Columbia University, has been appointed president and scientific director of the Applied Physics Research Foundation, Palo Alto, Calif.

Education

Steps to enable Cornell University's expanding "crash-injury" projects to work more effectively in the interest of the transportation industry and the travelling public have been announced. The crash-injury program aims to reduce death and injury from

transportation accidents through studies of crash survival. It is supported by industry, govenment agencies, and the military services. As a result of recent organizational changes, the aviation section of Crash Injury Research has become a division of the Cornell-Guggenheim Aviation Safety Center and has moved from the Cornell Medical College to the Center's quarters at 471 Park Ave., New York City.

The annual **Cornell Summer Laboratory Course in Techniques and Applications of the Electron Microscope** will be given, June 14–26, by the Laboratory of Electron Microscopy in the Department of Engineering Physics. Under the direction of Benjamin M. Siegel, it will have James Hillier of Melpar, Inc., Alexandria, Va., and C. E. Hall of the Massachusetts Institute of Technology as guest lecturers. The course is designed for those research workers, institutional and industrial, who have recently entered the field of electron microscopy or who are now planning to undertake problems involving application of this instrument. Inquiries should be addressed to Dr. Benjamin M. Siegel, Dept. of Engineering Physics, Cornell University, Ithaca, N.Y.

The **Hawaii Marine Laboratory** announces the completion of new research rooms and apartments for visiting investigators at its Coconut Island branch. The added facilities were made possible in part by a gift from Edwin W. Pauley. Applications for laboratory space and living quarters during any part of the year may be made to the Director, University of Hawaii, Honolulu.

Hans A. Krebs, professor of biochemistry, University of Sheffield, England, and Nobel Laureate in Medicine, will deliver Western Reserve University's 57th Hanna Lecture on Apr. 30 in the Allen Memorial Medical Auditorium, Cleveland.

Grants and Fellowships

The first and only award recognizing an individual's efforts to advance the technique, art, or science of **air pollution control** in this country has been established by the Air Pollution Control Association, Pittsburgh, Pa. The award, to be known as the Frank A. Chambers Award in honor of the early advocate of the "engineering approach" to air pollution control problems, will be presented at each annual meeting. This year's meeting will be held in Chattanooga, Tenn., May 3–6.

Allied Chemical & Dye Corporation of New York City has announced the award of 38 graduate fellowships for the academic year 1954–55 to stimulate advanced study in chemical and related fields and to develop skilled scientific leadership. The fellowships will provide $1500 for unmarried fellows and $2000 for married fellows, in addition to payment of tuition, and will be available in 27 universities and other educational institutions in the United States and Canada. Students in their final year of graduate study who have demonstrated an aptitude for research are eligible. Participating colleges will select the recipients and determine the research to be undertaken. The company exercises no control over the research work or the publication of results.

Nominations now are being accepted by The American Forestry Association for its seventh annual **conservation awards** to individuals who have contributed outstanding service in the field of conservation. Eligibility for nomination is not limited to persons actually working in the field of renewable natural resources. The awards, the first to be presented by a national organization to private citizens, are intended to recognize and reward individuals whose contributions to conservation have been beyond the demands of their regular means of livelihood. Five winners will be selected from as many categories, and for judging purposes nominees will be categorized on the basis of their primary employment rather than on the phase of conservation in which they have been active. The categories are public servants, business and industry, education, public information, and a classification that includes persons not embraced by the other four categories.

Presentation of the awards will be a highlight of AFA's 4-day annual meeting Sept. 6–9 in Portland, Ore. Nomination blanks for the 1954 awards may be obtained from The American Forestry Association, 919 17th St. NW, Washington 6, D.C.

Two fellowships for graduate work in the **Department of Aeronautical Engineering** at Princeton University have been established anonymously in memory of John Morris Legendre, class of 1925, who died in a plane crash in 1953. The two awards total $6000 a year.

Three full-time assistantships and a part-time graduate student fellowship are available to women applicants in the **Genetics Experiment Station at Smith College,** Northampton, Mass. The assistantships carry a salary of $2500 to $3000 per year; the fellowship, an honorarium of $1500 per year.

A new approach in hitherto unsuccessful attempts to establish **Hodgkin's disease**—a so-called cancer of the lymph glands—in experimental animals is now being made at the University of California School of Medicine as a result of a $12,000 research grant from the Dorothy H. and Lewis Rosenstiel Foundation.

The American League Against Epilepsy announces the **Jerry Price Memorial Prizes,** contributed jointly by Mr. and Mrs. Fred Markham and the League, for dissertations on epilepsy. The awards are $500, $200, and $300, and there are also book prizes and possible publication of one or more contributions in the journal *Epilepsia.*

The contest is open to the students of any approved

medical school in the United States or Canada. Any one of the many aspects of epilepsy may be covered. Essays should be original, typed double spaced, and preferably no more than 5000 words in length. *Contributions should be mailed before Aug. 1* to Dr. J. K. Merlis, American League Against Epilepsy, 150 S. Huntington Ave., Boston 30, Mass.

The Children's Division of the Institute of Physical Medicine and Rehabilitation, New York University-Bellevue Medical Center, which is a joint undertaking with the Association for the Aid of Crippled Children, has announced the availability of a fellowship for a graduate professional nurse in **pediatric rehabilitation.** The fellowship, which, for a period of 6 mo, pays a stipend of $1500, is open to graduates of approved schools of nursing who have had a minimum of two years' experience, either in hospital or public health nursing. Six months of specialized clinical experience in nursing in the rehabilitation of physically handicapped children will be provided; some experience in working with adults will also be included. Applications may be made to Miss Mary Stewart, Children's Division, The Institute of Physical Medicine and Rehabilitaton, 400 E. 34 St., New York 16.

A limited number of fellowships for social scientists interested in the emotional, psychological and social factors related to the **rehabilitation of physically handicapped** persons were announced today by the National Foundation for Infantile Paralysis. These fellowships will be awarded to established professional workers or unusually promising graduate students who have completed a minimum of 2 yr of work toward the doctorate in one of the social sciences. The candidate must have the intention of working with the physically handicapped upon completion of the fellowship. Because the National Foundation is particularly interested in the unique problems of poliomyelitis patients with persisting respiratory difficulties, special consideration will be given to applicants planning to include work at a medical center concerned with rehabilitation where the opportunity for working with respirator cases is available.

Awards are based on individual needs of each applicant and will include an allowance for tuition, fees, and maintenance. Appointments will be made for 1 yr, but may be renewed. Partial fellowships are available for qualified veterans to supplement G.I. educational benefits. Application forms may be obtained from the Division of Professional Education, National Foundation for Infantile Paralysis, 120 Broadway, New York 5.

A new edition of the publication, ***Training and Research Opportunities under the National Mental Health Act,*** which has been revised to reflect recent policy changes with respect to traineeships (formerly called "stipends") and research fellowships, is available from the National Institute of Mental Health, Bethesda 14, Md. In addition to traineeships available in psychiatry, psychiatric nursing, psychiatric social work, and clinical psychology, a fifth area of study known as "public health mental health" has been added. These public health mental health traineeships are available to psychiatrists, clinical psychologists, psychiatric social workers, public health nurses with undergraduate degrees, and public health officers.

Research fellowships are now awarded to postdoctorate investigators only. This program is designed to assist young scientists and physicians in obtaining training and experience in research techniques and methodology which may be applied to the problems of mental health and illness. These fellowships are available to qualified research workers in such fields as biochemistry, neurophysiology, psychiatry, psychology, and sociology. The new edition of the pamphlet also includes more detailed information on the policies and procedures of the research grant program of the National Institute of Mental Health. If the person who is interested in applying for a traineeship will indicate in which profession he wishes to apply, a list of the universities and training centers awarding Public Health Service traineeships in that profession will be enclosed with the pamphlet. Copies of the pamphlet may also be purchased for 10 cts each, with a 25-percent discount on orders for 100 or more to be sent to one address, from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

The **Zoological Society of San Diego, Calif.** announces a fellowship available to graduate students and post-doctoral research workers at the Biological Research Institute. The problems pursued should make use of materials in the Zoological Garden and may include such branches of animal biology as pathology, bacteriology, parasitology, physiology, veterinary medicine, comparative anatomy, comparative biochemistry, animal nutrition, or animal psychology. The stipend is $2000.

Applications should be in the form of a letter, furnishing full information regarding academic preparation, degrees, letters of recommendation, and an outline of the proposed study. *Applications must be submitted not later than May 1.* Address Glen G. Crosbie, Biological Research Institute, Balboa Park, San Diego.

Meetings and Elections

The **American College of Cardiology** will hold its third annual convention in Chicago, May 27–29. An interesting program has been arranged which will be based on the topic "Prognosis of Heart Disease." Prominent guest speakers will participate in the scientific sessions, and in addition there will be exhibits outlining the latest advances in the field of cardiology. Further information may be obtained from the secretary of the College, Dr. Philip Reichert, 140 W. 57 St., New York 19.

The 45th annual meeting of the **American Home Economics Association** will be held in San Francisco, July 6–9. More than 3000 home economists are ex-

pected to attend. General sessions will feature education in one world, the importance of research in today's world, and the influence of world economics on standards of living for the world's families. Beulah V. Gillaspie, dean of the School of Home Economics at Purdue University and 1st v.-pres. of the Association, is chairman of the program committee.

The Pennsylvania State University will be host this summer to the **49th annual meeting of the American Dairy Science Association,** June 22–24. Approximately 1600 delegates from the United States and Canada are expected to attend. Technical research papers, symposia, and organized discussions on all phases of dairying will be features of the meeting. Interested persons are urged to write to the Registration Committee, Dairy Department, State College, Pa., for information.

Several thousand psychiatrists will convene May 3–7 in St. Louis, Mo., for the **110th Annual Meeting of the American Psychiatric Association.** With a membership of 7600, APA is the leading professional society for psychiatrists of the U.S. and Canada. Over 100 papers on recent developments in pyschiatry will be presented, together with psychiatric films and exhibits. Nonmembers are welcome to attend the scientific sessions. Information may be obtained from Robert L. Robinson, 1785 Massachusetts Ave. NW, Washington 6, D.C.

"Aviation and Electronics Look Ahead" will be the theme of a meeting scheduled for Apr. 22–23 at the Franklin Institute in Philadelphia. It is sponsored jointly by the Radio Technical Commission for Aeronautics, The Franklin Institute Laboratories for Research and Development, the Institute of the Aeronautical Sciences (Philadelphia section), and the Institute of Radio Engineers, Professional Group on Aeronautical and Navigational Electronics (Philadelphia chapter). Outstanding speakers, including K. C. Black of the Polytechnic Research and Development Co., Brooklyn, will present authoritative analyses on the economic aspects of future air transportation and its potential new markets, the design and operation of tomorrow's airports, and current and coming trends of development in electronic devices, fixed-wing aircraft, convertible aircraft, and helicopters.

A special feature of the program will be a presentation, "Destination Saturn," in the Fels Planetarium on the evening of Apr. 22. This will be a simulated flight in a space ship, illustrating electronics, navigation, and communications problems of interplanetary travel. Nonmembers may attend any of the sessions.

Incorporated in the District of Columbia, a new organization called **Citizens for Conservation** has been formed to promote the conservation of human and natural resources at the community level. Most of the societies and associations concerned with conservation operate on the national level, and many are directing their efforts toward the conservation of single resources such as forests and wildlife. The new group will fill a major gap by enlisting the support of communities and the general public in conserving community as well as national resources.

Officers of Citizens for Conservation are: pres., Gerald P. Nye, former U.S. Senator from North Dakota; sec., Clarence C. Case, formerly with the Michigan Dept. of Economic Development; and treas., Daniel W. Bell, president of the American Security and Trust Company. In addition to the officers, directors are John A. Behnke, associate administrative secretary of AAAS; Howard A. Meyerhoff, president of the Scientific Manpower Commission; John E. Hartshorn, attorney; and Fred Packard, executive secretary of the National Parks Association. Headquarters of the organization have been established at 1710 16th St. NW, Washington, D.C.

The **First International Instrument Congress and Exposition,** sponsored by the Instrument Society of America, has already received contracts from 287 exhibitors for 573 booths at the Philadelphia Convention Hall, Sept. 15–21. The show increased its exhibit area from 10,000 ft² in 1946 to 35,000 ft² in 1953, and the exhibit area so far sold for the 1954 show totals 57,000 ft². With only a few booths still available, the show management has found it necessary to contract for additional space which will increase the display area another 25 percent.

The attendance at the 1953 Instrument Conference and Exhibit was slightly over 11,000. More than 25,000 visitors from all parts of the country and many foreign countries are expected to attend the present Congress and Exposition. For further information address the Managing Director, First International Instrument Congress and Exposition, 845 Ridge Ave., Pittsburgh 12, Pa.

The Council of the **International Scientific Film Association** (38, Avenue des Ternes, Paris 17) at its meetings on Jan. 8–9 in Paris agreed, with the Italian Delegation, to the various arrangements for the Association's 8th annual congress which will take place in Rome at the end of October, 1954. In accord with UNESCO's experts on the subject, the Council gave its approval to the results so far obtained in establishing a central register of data on the films chosen for the Association's annual congresses (500 films from some 30 countries). The Council endorsed a plan whereby the French Institut de Cinématographie Scientifique would produce a series of "international science-magazine" films.

The International Scientific Film Association has accepted invitations to organize the presentation of international programs of scientific films at the First International Film Festival of São Paulo (Brazil) and at the International Festival of Documentary and Experimental Films of Montevideo (Uruguay). The President of the I.S.F.A., Jean Painlevé, will represent the Association at these Festivals. All inquiries

should be addressed to The Scientific Film Association, 164 Shaftesbury Ave., London W.C.2.

The 86th annual meeting of the **Kansas Academy of Science** will be held at Hays, Apr. 29–May 1. Fort Hays Kansas State College will be host to the Academy and Dr. H. S. Choguill, professor of chemistry, is the local chairman in charge of arrangements. There will be general sessions covering the usual range of subjects dealing with botany, chemistry, geology, microbiology, physics, psychology, and zoology. President R. E. Mohler, McPherson College, will give an address at the annual banquet. President-elect A. C. Carpenter will be toastmaster.

The **Mathematics Division of the American Society for Engineering Education** has planned an instructive program for the A.S.E.E. meetings to be held at the University of Illinois, June 14–18. Richard S. Burington, Bureau of Ordnance, Department of the Navy, is chairman of the Mathematics Division and is in charge of the program.

The sessions of June 16 will be devoted to a panel discussion on "Problems of training in the use of computing equipment," led by C. V. L. Smith of the Office of Naval Research. Members of the panel will include: W. H. Boghosian, University of Pennsylvania; John W. Carr, University of Michigan; W. J. Eckert, Watson Scientific Computing Laboratory; M. R. Hestenes, University of California; Phillip M. Morse, M.I.T.; and F. J. Murray, Columbia University.

On June 17 C. V. Newsom, Associate Commissioner of Higher Education, State of New York, will give his retiring address on "The introductory college course for engineers." In addition, there will be a number of lectures by other recognized authorities, including G. B. Price of the University of Kansas, B. Meserve of the University of Illinois, Karl Menger of the Illinois Institute of Technology, C. O. Oakley of Haverford College, L. W. Cohen of the National Science Foundation, and J. Weyl of the Office of Naval Research.

"The place of mathematical statistics and probability theory in engineering curricula" is the subject of another discussion to be conducted by Wm. P. Pabst of the Bureau of Ordnance, Department of the Navy. The members of this panel have been selected to reflect various points of view in industry, government, and education, and include J. H. Davidson of the General Electric Company, Forest Blanding of the Standard Oil Development Company, and I. Burr of Purdue University.

Roger H. Charlier of Chester, N.J., has been chiefly responsible for organizing the **New Jersey Academy of Science.** The first members have signed up, and other interested persons are urged to participate.

The **XIXth Cold Spring Harbor Symposium on Quantitative Biology** will take place at Cold Spring Harbor, Long Island, N.Y., June 7–14. The topic is "The Mammalian Fetus: Physiological Aspects of Development." It is being organized, as always, by the Cold Spring Harbor Biological Laboratory and is being sponsored by the Carnegie Corporation of New York, the National Science Foundation, and the Association for the Aid of Crippled Children. A list of the European participants follows:

E. C. Amoroso, Royal Veterinary College and Hospital, University of London.

Finn Böe, Research Division, Biological Department, Nyegaard & Co., Oslo, Norway.

F. W. Rogers Brambell, Dept. of Zoology, University College of North Wales, Bangor, Caernarvonshire, Wales.

J. C. McClure Browne, Institute of Obstetrics and Gynaecology, Postgraduate Medical School of London.

K. W. Cross, Physiology Dept., St. Mary's Hospital Medical School, London.

G. S. Dawes, Nuffield Institute for Medical Research, Oxford, Eng.

A. D. M. Greenfield, Dept. of Physiology, The Queen's University of Belfast, Northern Ireland.

J. P. Hoet, Hospital St. Pierre, Louvain, Belgium.

A. St. G. Huggett, Dept. of Physiology, St. Mary's Hospital Medical School, London.

Alfred Jost, Laboratory of Animal Biology, Faculty of Sciences, University of Paris.

M. J. Karvonen, Institute of Occuptional Health, Helsinki.

Ester M. Killick, Royal Free Hospital School of Medicine, London.

John Lind, Norrtulls Hospital, Stockholm.

R. A. McCance, of Experimental Medicine, Cambridge, Eng.

E. F. McCarthy, Low Temperature Laboratory, Medical Research Council of Ireland, Dublin, Erie.

A. S. Parkes, National Institute for Medical Research, Mill Hill, London.

G. Popjak, Experimental Radiopathology Research Unit, Hammersmith Hospital, London.

C. E. Räihä, Childrens Clinic, Helsinki.

James Walker, Dept. of Obstetrics and Gynaecology, University of Aberdeen, Aberdeen, Scotland.

G. B. West, Dept. of Pharmacology and Therapeutics, Medical School, Dundee, Scotland.

Miscellaneous

A 200-page report containing 15 papers presented at an **atomic power symposium** held at Chalk River last September has been published by Atomic Energy of Canada Limited. The 3-day symposium was attended by 75 engineers, business executives, and other representatives of private industrial firms who received the most comprehensive view of research results at Chalk River ever presented to private industry. The report costs $2.00 and is available from the Scientific Documents Office of the Crown Company at Chalk River, Ont.

The second in the 1954 Spring Series of **March of Medicine** network telecasts, presented by Smith, Kline

& French Laboratories and the American Medical Association, will bring to a nationwide audience a glimpse into current research on the problem of arthritis and rheumatism. The program, scheduled for Thurs., Apr. 29, at 10 p.m. EDT, will be carried over some 78 stations of the NBC television network. By means of actual live telecasts and by film, the program will visit medical research centers throughout the country where work is underway on this important problem in the field of degenerative disease.

The American Standards Association, 70 E. 45 St., New York, has announced that a **new international standard for testing electronic parts** used in radio communication and electronic apparatus has been published by the International Electrotechnical Commission (IEC), a commission composed of the national committees of 30 member nations. The document represents several years work by an IEC Technical Subcommittee on Electronic Components. E. F. Seaman of the U.S. Navy Bureau of Ships is chairman of the subcommittee.

The purpose of the new International Recommendation is to meet an urgent need for a standard international language in testing and rating electronic components for the various service conditions encountered in climates around the world and in the service conditions of land, sea, and airborne apparatus. However, recommendations of the standard are for conventional electrical apparatus; they are not intended for the military, where unusual conditions must be met. The 52-page work is identified as "Publication 68—Basic Climate and Mechanical Robustness Testing Procedure for Components."

Although there has been a gradual decrease in the number of applications for **scientific positions** during the past few months, qualified scientists are still urgently needed in various Federal agencies in the Washington, D.C., area. Salaries range from $3410 to $10,800 a year. For detailed information inquire of the U.S. Civil Service Commission, Washington 25, D.C., or any one of its regional offices.

"Training the Conservation Worker," a 7-page leaflet, is now available from the Conservation Project of the National Association of Biology Teachers. The leaflet contains suggestions on forestry training by O. F. Hall; on wildlife training by Robert A. McCabe; on fisheries training by Karl F. Lagler; on recreation training by William H. Marshall; and on teacher training by Richard L. Weaver. These five conservationists summarized their suggestions in a symposium held recently at the University of Wisconsin cooperatively sponsored by NABT and the American Institute of Biological Sciences. The leaflet was reprinted from the January 1954 issue of the AIBS *Bulletin*. Orders for the reprint, which costs 10 cts, should be addressed to Dr. L. Weaver, Conservation Project Leader, P. O. Box 2073, Ann Arbor, Mich. There is a 20-percent discount on orders of 100 or more.

The U.S. Atomic Energy Commission has announced the transfer of the feed materials production responsibilities of its New York office to the Oak Ridge Operations Office, effective July 1. The Commission will maintain a New York office to supervise the Health and Safety Laboratory at 70 Columbus Ave., New York; about 275 research and development contracts, chiefly at universities and laboratories; and the Brookhaven National Laboratory at Upton, N.Y. The consolidation of these production functions under Oak Ridge is designed to achieve greater efficiency and economy in the national atomic energy program.

UNESCO has been requested to assist in recruiting suitable candidates for the following **vacant posts.** The information presented is as of Jan. 31. The teaching language is indicated in brackets.

Burma

Professors of agronomic chemistry and soil chemistry; plant breeding; plant pathology; agronomic entomology; hydrobiology; and an adviser on agronomic research. Agronomic Research and Teaching Institute, Rangoon. (English)

Professors of anatomy; physiology; pharmacology; and pathology. Medical School, University of Rangoon. (English)

Professors of electrical engineering (power); civil engineering (and soil mechanics); mechanical engineering (specialty, refrigeration and air conditioning). Engineering School, University of Rangoon. (English)

Ecuador

Professor and director of astronomic observatory. University of Quito. (Spanish)

Israel

Professor and lecturer in physiology; professor of pharmacology, Medical School, University of Jerusalem. (German or English) Preference to candidates with knowledge of Hebrew; Mosaic religion not required.

Liberia

Professors of mathematics; physics; chemistry; and biology (either zoology or botany). University of Monrovia. (English)

Two teachers of biology, for two colleges (Secondary school level). (English)

Pakistan

Professors of mathematics; philosophy; psychology; Islamic learning; political science and international affairs. University of Karachi. (English)

Turkey

Professor of mathematics. University of Ankara. (German, English, or French)

Three professors of meteorology; and one for geology. Technical University of Istanbul. (German, English, or French)

Most of the posts are vacant now, or from the beginning of the next academic year. Those interested are invited to write for details to the Exchange of Persons Program of UNESCO, 19 Avenue Kléber, Paris 16e.

Technical Papers

The Saturation Curves of Cinnabar and Metacinnabar in the System HgS–Na_2S–H_2O at 25° C[1]

Frank W. Dickson[2] and George Tunell
Institute of Geophysics and Department of Geology, University of California, Los Angeles

In connection with an investigation of quicksilver ore deposits, the objective of which is to learn more about the physico-chemical processes by which they originated, we have determined at 25° C the portions of the saturation curves of cinnabar and metacinnabar in the system HgS–Na_2S–H_2O that extend from the H_2O corner of the triangle to points beyond the line H_2O-equals-75-percent-by-weight. We are continuing this work and shall carry it to higher temperatures approaching 100° C as nearly as is possible with an open thermostat.

Preparing and purifying reagents and solutions. The Baker and Adamson reagent grade red HgS (artificial cinnabar) used in this experiment contained substances insoluble in Na_2S. Leaching with sodium hydroxide reduced the content of such impurities to less than 0.01 percent. Black HgS (artificial metacinnabar) was made by dissolving red HgS in Na_2S solution and precipitating as black HgS. 'Baker Analyzed' Reagent grade $Na_2S \cdot 9H_2O$ was rinsed with distilled water, and clear colorless material was set aside for use. Saturated Na_2S stock solution was made up from boiled distilled water in an oxygen-free nitrogen atmosphere.

Establishing equilibrium. Bottles containing fine-grained red or black HgS and solutions of Na_2S were rotated in a constant temperature bath at 25.00° C (± 0.03° C) for periods of time ranging from 10 hr to several weeks. Na_2S and HgS content of solutions from cinnabar-solution mixtures (two-phase) kept in the bath for 1 wk agreed with the Na_2S and HgS content of solutions from cinnabar-solution mixtures kept in the bath for 2 wk and longer, indicating that equilibrium was closely approximated. Metacinnabar-solution mixtures (two-phase) were kept in the bath 24 hr or less because of the tendency of metacinnabar to invert slowly to cinnabar. Samples containing less than 3 percent by weight of Na_2S were kept in the bath for 24 hr, and those containing more than 6 percent by weight Na_2S for 10 hr. Solution compositions plotted on the triangular diagram fall on a smooth curve, indicating that metastable equilibrium between metacinnabar and Na_2S solutions was attained. The identity of the solid phases was established by means of the x-ray spectrometer and by means of the optical microscope. The optical method was found to be much more sensitive than the x-ray method for detecting slight traces of cinnabar in the metacinnabar; no cinnabar was found in samples that contained less than 3 percent Na_2S, and only a trace (less than 0.1 percent) of cinnabar was detected in samples that contained more than 6 percent Na_2S.

TABLE 1. Solubility of cinnabar in sodium sulfide solutions at 25.00° C (± 0.03° C).

Percentage by weight		
Na_2S	HgS	H_2O (by difference)
0.95	0.21	98.84
1.50	.57	97.93
2.31	1.34	96.35
3.58	2.91	93.51
4.37	4.12	91.51
6.07	7.29	86.64
9.64	15.59	74.77

TABLE 2. Solubility of metacinnabar in sodium sulfide solutions at 25.00° C (± 0.03° C).

Percentage by weight		
Na_2S	HgS	H_2O (by difference)
0.51	0.11	99.38
1.37	.79	97.84
2.85	2.76	94.39
6.55	10.24	83.21
10.93	20.70	68.37

Method of analysis. The saturated solutions were analyzed for mercury, sodium, and sulfur. In preparation for analysis, the solutions were quickly filtered through a fritted glass crucible to remove suspended solid HgS. To a sample of saturated solution, previously weighed into a beaker and diluted with water, concentrated hydrogen peroxide solution (30 percent H_2O_2) was added. The excess sulfide oxidized to sulfate, diminishing the sulfide-ion concentration and causing mercury to precipitate as black mercuric sulfide. The black HgS was filtered in a fritted glass crucible, weighed, and the concentration of HgS was calculated in grams HgS per gram solution. The filtrate was analyzed for sodium or sulfate by weighing as sodium sulfate or barium sulfate, respectively, and the Na_2S concentration was calculated. Water content was determined by difference. The analytical data are presented in Tables 1 and 2.

The saturation curves of cinnabar and metacinnabar at 25° C. The portions of the saturation curves of cinnabar and metacinnabar in the system HgS–Na_2S–H_2O at 25° C from the H_2O corner to points beyond the line H_2O-equals-75-percent-by-

[1] A report on research carried out under the auspices of the Office of Naval Research.
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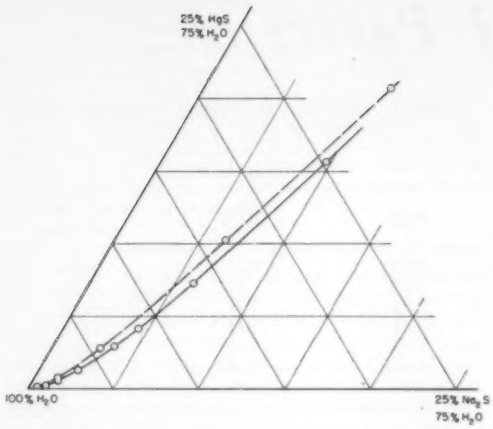

FIG. 1. The saturation curves of cinnabar and metacinnabar in the system HgS–Na_2S–H_2O at 25° C from the H_2O corner to points beyond the line H_2O-equals-75-percent-by-weight. The dashed line represents the saturation curve of metacinnabar; the solid line, the saturation curve of cinnabar. The small circles represent analyses of saturated solutions.

weight are shown in Fig. 1. The analyses of the solutions saturated with cinnabar and with metacinnabar at 25° C are represented by small circles in this figure.

Previous work by Knox (*1*) had shown that in Na_2S solutions there is a marked increase of solubility of cinnabar and metacinnabar with increasing concentration of Na_2S. Knox determined the concentrations of HgS in the saturated solutions in grams per cubic centimeter, and his data were therefore insufficient to determine the exact positions of the saturation curves in a triangular equilibrium diagram.

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Effect of Cortisone on Experimental Murine Typhus in Mice[1]

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Studies concerning the effect of cortisone and other adrenal cortical hormones on infectious diseases have attracted considerable attention during the past few years. Cortical hormones have been shown to increase the susceptibility in a number of hosts to many unrelated bacterial and viral diseases (*1*). Owing to the lack of a highly susceptible animal for studying experimental infections with typhus rickettsiae, the possibility that cortisone might enhance the susceptibility of mice to murine typhus seemed worthy of invesigation.

The inoculum used in these experiments consisted of yolk-sac material infected with *Rickettsia mooseri*. Heavily infected yolk sacs harvested from viable chick embryos were diluted to 10 percent by weight with 0.5 percent sterile skim milk and ground in a sterile cold Waring Blendor for 10 sec. Immediately prior to inoculations for infectivity titrations, the inoculum was titrated by the mouse toxicity test (*2*) to provide information on the relative potency of the inoculum used for each experiment. Twofold dilutions (1 : 10 to 1 : 10,240) were inoculated intraperitoneally in 0.5-ml amounts in the infectivity tests.

Four strains of mice were tested: albino, C strain, NHF_s (*3*), and dba mice, which ranged in weight from 15 to 22 g (*4*). The cortisone was injected subcutaneously in 0.2-ml doses (*5*).

TABLE 1. Effect of cortisone on the susceptibility of various strains of mice to murine typhus.

Cortisone dosage (mg)	Strain of mice infectious LD_{50}					
	White*	C*	White*	NHF_s*	White†	Dba†
1.25	1280	2580	1280	4190	1600	1280
2.5					3900	2560
5.0					< 5120	10240
0.0	185	690	185	115	240	200

* Toxic dose 1 : 50.
† Toxis dose 1 : 65.

To determine the effects of varying dosage of cortisone on their susceptibility, white mice were given 0.625, 1.25, 2.5, 5.0, and 10.0 mg cortisone 4 hr prior to injection of the infectious suspension. No adverse effects of cortisone treatment were evident in control mice when 5.0 mg or less was used, whereas 10.0 mg produced several deaths on the 7th and 8th days after inoculation. Mice were observed for a period of 10 days. By using an inoculum with a toxic LD_{50} of 1 : 130, the following infectious LD_{50}s (*6*) were obtained: mice receiving no cortisone, 1 : 250; 0.625 mg, 1 : 1280; 1.25 mg, < 1 : 2560; 2.5 mg, 1 : 1750; and 5.0 mg, 1 : 1500. The results of this experiment indicated that the use of as little as one pretreatment of 0.625 mg greatly increased the susceptibility of white mice to murine typhus infections.

To determine the best time to administer the cortisone relative to the injection of infectious material, white mice were given a single dose of 1.25 mg of cortisone at 0, 4, 7, 16, 20, and 24 hr prior to infection and 24 hr after infection. The maximum effectiveness of 1.25 mg of cortisone was reached 4 to 16 hr after it was administered subcutaneously. The period of maximum effectiveness of other dosages of cortisone given subcutaneously to mice was not determined. Using an inoculum with a toxic LD_{50} of 1 : 14, the

[1] This investigation was supported by a research grant from the U.S. Public Health Service and, in part, by a grant by the University of Kansas.
[2] The technical assistance of Miriam M. Meyer is gratefully acknowledged.

following infectivity LD_{50}s were obtained: no cortisone, 1 : 30, 0 hr, 1 : 65; 4 hr, 1 : 230; 7 hr, 1 : 220; 16 hr, 1 : 205; 20 hr, 1 : 70; 24 hr prior, 1 : 70; and 24 hr after, 1 : 190.

The results presented here demonstrate quite readily that cortisone greatly increases the susceptibility of white mice to murine typhus. In Table 1, evidence is presented concerning the effect of cortisone on infection in other strains of mice as compared with white mice. Cortisone-treated white mice were found to be 7 times as susceptible as untreated mice. The susceptibility of NHF_8 mice was increased more than 40 times. Cortisone treatment of the C strain, which was routinely more susceptible than the white mice, showed an increase of only a little more than 4 times that of the untreated mice. The effects of cortisone on the dba mice seemed to be approximately equal to those on white mice when 1.25 or 2.5 mg was administered. Although the titration with white mice is not complete, 5 mg appeared to have a greater effect on the dba mice than on the white mice. With the 1 : 5120 inoculum, the average day of death (ADD) for white mice was 9.25, whereas for the dba it was 5.0.

Jackson and Smadel (*9*) reported that 0.1 to 1.25 mg cortisone administered over 2.5 days had no effect on the susceptibility of mice to toxins of *Rickettsia tsutsugamushi*, *Rickettsia prowazeki*, or *Salmonella typhosa*. We have found that there is little or no effect on the susceptibility to toxin of *R. mooseri* where 1.25 to 2.5 mg of cortisone was administered 4 to 12 hr prior to titration. White mice receiving 2.5 mg 4 hr prior to toxic titration gave a toxic LD_{50} of 1 : 80, while controls gave 1 : 50. When 1.25 mg was given 12 hr prior to toxic titration, the following toxic LD_{50}s were obtained: white mice, untreated and treated, respectively, 1 : 90, 1 : 65; dba mice, untreated and treated, respectively, 1 : 90, 1 : 145.

Cortisone treatment of mice seems, therefore, to enhance the susceptibility of this animal to infection with *R. mooseri*, and the presence of smaller numbers of rickettsiae is indicated by death of mice following injection of infectious material. With the use of cortisone-treated animals, it seems possible that a more rapid diagnostic method could be developed and that experimental typhus infections could be more readily studied.

Smaller numbers of rickettsiae caused death of NHF_8 and dba mice than of white mice after cortisone treatment. This would indicate that the use of these strains of mice would be valuable in studies using *R. mooseri*.

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Preparation of Isotopic Lithium Metal by Thermochemical Reduction[1]

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In conjunction with the portion of the program of the Stable Isotope Research and Production Division of the Oak Ridge National Laboratory dealing with the measurements of physical properties of isotopes and their compounds (*1*), small quantities of lithium metal were needed. Since the commercial techniques apparently are suitable only for quantities of 10 lb of salt or more and, thus, could not be used for the small isotopic amounts of the order of 0.5 to several grams, it became necessary to investigate other possible small-scale methods.

Preliminary work with miniature electrolytic cells of our own design showed them to be usable; but, both because of the holdup and because of the longer time required to carry out reduction, an electrolytic procedure was still somewhat less satisfactory than had been desired. Hence, the work turned toward thermochemical possibilities.

Earlier investigators had tried various reducing agents under different conditions, as is indicated in Table 1; but, with the exception of some of the vacuum metallurgical processes involving the reactions of oxy-compounds of lithium with aluminum, silicon, or ferrosilicon, the procedures were not very satisfactory. We found that the $FeSi_6$-LiOH-CaO reaction of the National Research Corporation gave a satisfactory product, but we objected to the necessary high vacuum and high temperature.

TABLE 1. Previous investigations.

Year	Investigator	Thermochemical reaction
1857	Troost (*2*)	$Na + LiCl$
1896	Warren (*3*)	$Mg + LiOH$
1913	Hackspill (*4*)	$Ca + LiCl$
1943	National Research Corp. (*5*)	$Fe + Li_2CO_3$
1944	National Research Corp.	$FeSi_6 + CaO + LiOH$ (or Li_2CO_3)
1947	Kroll and Schlechten (*6*)	Al (or Si) + $CaO + Li_2O$
1947	Stauffer (*7*)	$FeSi_6$ (or Al-Si alloy) + Li_2O

The work of Jellinek and Czerwinski (*8*) dealing with the equilibria of the system Ba-LiCl-Li-$BaCl_2$ suggested barium as a possible reducing agent for obtaining lithium from lithium chloride. Some exploratory work in our laboratory showed that the reaction was suitable; and, subsequently, the following procedure for producing and handling lithium metal was developed.

[1] This paper is based on work performed for the AEC by Carbide and Carbon Chemicals Co., a division of Union Carbide and Carbon Corp., at the Oak Ridge National Laboratory.

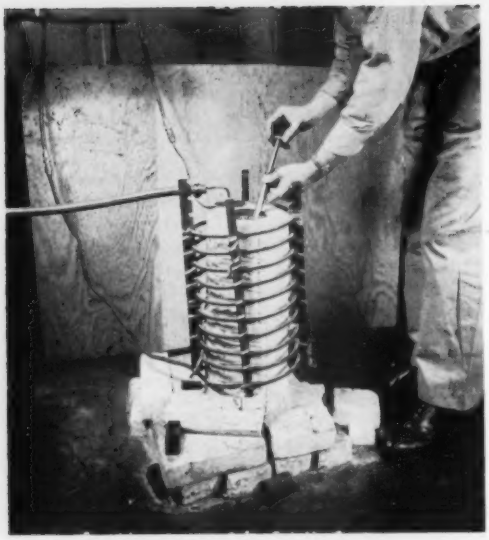

FIG. 1. Pipetting molten lithium.

Lithium chloride and barium metal—the latter in quantity about 80 percent of the stoichiometric requirement—are placed in a container that is enclosed in a heavy-walled stainless steel system. As a precautionary safety measure to prevent any atmospheric oxidation, the system is placed under 5 to 10 lb positive argon pressure by alternately evacuating it and charging it with argon. The system is then heated by induction heating, using a 20-kw, 220-kc Megatherm (*9*) unit, to a temperature of about 850° C, where it is held for 20 min. The reactor is cooled slowly to about 300° C, the cover is removed, and the molten lithium metal, which is resting on top of a solid $BaCl_2$-LiCl salt mixture, is poured into mineral oil.

The metal produced in this manner contains 5 to 8 percent impurities, mostly barium. The barium content may be reduced to a much lower value by reheating the metal with an excess of fresh lithium chloride to about 650° C, and holding this temperature for 15 min before cooling again to 300° C and pouring into oil.

In cases where small quantities of metal are involved, the metal may be pipetted from the surface of the salt after the "cleanup" step by remelting the salt and then using a stainless steel pipet which can be operated either by a plunger or by suction through a plastic tube (Fig. 1). By appropriate choice of the amount of cleanup salt, the barium content may be reduced to about 0.1 percent and the total impurities to about 0.5 percent. Table 2 shows the effects of various treatments upon the final purity of the metal.

Yields of lithium metal amounting to 85 percent, based on barium, are common for metal of 92 to 95 percent purity. Where the purity is 98 to 99 percent, the yield decreases to about 60 percent in the larger batches and to less in smaller batches; much of the loss is attributable to the difficulty in removing metal that is physically entrapped in the solid salt. (This latter yield may be improved significantly by remelting the salt, stirring to coalesce the metal, and then removing with a pipet whatever metal floats to the top.)

TABLE 2. Effects of various treatments.

Treatment	Impurities (%)
Reduction of LiCl with stoichiometric amount of barium	~ 12
Reduction of LiCl with 80% of stoichiometric amount of barium	~ 8
Cleanup, 1.5 g fresh LiCl per gram of 92% metal	~ 4
Cleanup, 4 g fresh LiCl per gram of 92% metal	1.5
Cleanup, 50 g fresh LiCl per gram of 92% metal	0.5

Once the metal has been poured into mineral oil, it may be remelted by heating the oil to about 190° C, and then it may be cast into any desired shapes or sizes without particular difficulty. Under oil in tightly closed containers, the lithium metal retains a mirror-like appearance for years.

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Quaternary Ammonium Compounds as Molluscacides

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In a screening study of the killing power of chemicals on fish *Poecilia vivipara* and *Lebistes reticulatus*, we observed that some quaternary ammonium compounds which kill them within 1 hr at a concentration of 5 ppm or less also kill *Australorbis* sp. snails at the same concentration within 24 hr, and that the limit of active concentration is almost the same for both fish and molluscs, especially when the fish used are no larger than 3.0 cm. These facts were observed with cetylpyridinium chloride, cetyltrimethylammonium bromide, cetyldimethylammonium bromide, dimethyl-

benzylammonium chloride, diisobutylcresoxyethoxyethyldimethyl-benzylammonium chloride, and with other molluscacides, including copper sulfate and sodium pentachlorophenate.

In comparison with other molluscacides known, the quaternary ammonium compounds are of lower toxicity for humans and domestic animals, hence a screening test was designed to detect those of highest killing power against *Australorbis* sp. snails.

Snails were collected in the city of Santos, where schistosomiasis is endemic in some suburban areas and where *A. immunis* (Lutz, 1918) is the prevalent species (*1*).

To compare the molluscacide activity of quaternary ammonium compounds, concentrations from 30 to 1 ppm, made in 500 ml of tap water, were left standing in 1 l wide-mouthed flasks. Fifty carefully selected, mature, active, medium-sized snails were used for each solution. Parallel tests were made with a technical grade sodium pentachlorophenate. Table 1

TABLE 1. Percentage dead rate of *Australorbis* sp. snails after 48 hr of contact time in different concentrations of aqueous solutions of quarternary ammonium compounds.

Chemicals	Parts per million						Trade mark, manufacturers, or suppliers
	30	20	10	5	2.5	1	
Sodium pentachlorophenate	100	100	100	100	100	94	Santobrite Lot U. 469 Tec. Grade Monsanto
Cetylpyridinium Cl	100	100	100	100	92	1	Chemo Puro Mfg. Corp.
Cetyldimethylammonium Br	100	100	100	100	64	4	Ethyl Cetab. Lot No. 09-C-009 Rhodes Chemical Corp.
Cetyltrimethylammonium Br	100	100	100	100	92	26	Bromat Fine Organics Inc.
Cetyldimethylethylammonium Br	100	100	100	100	100	80	Ammonix Dme Onyx Oil & Chemical Co.
Cetyltrimethylethylammonium Br	100	100	100	100	100	80	Ammonix Trm Onyx Oil & Chemical Co.
Cetyldimethylbenzylammonium Cl	100	100	100	96	54	0	Ammonix G Onyx Oil & Chemical Co.
Alkyldimethylbenzylammonium Cl	100	100	32	0	0	0	B T C Onyx Oil & Chemical Co.
Alkyldimethylbenzyldimethylammonium Cl	100	100	100	84	62	0	B T C 927 Onyx Oil & Chemical Co.
Alkylethylbenzyldimethylammonium Cl	100	100	100	100	18	0	B T C 471 Onyx Oil & Chemical Co.
Dimethylbenzylammonium Cl	100	100	100	80	10	0	Roccal Winthrop Stearns
Alkyldimethyl-3,4-dichlorobenzylammonium Cl	100	100	94	70	16	0	Tetrosan 3,4 D Onyx Oil & Chemical Co.
Octadecenyldimethylethylammonium Br	100	100	100	100	90	4	Onyxide Onyx Oil & Chemical Co.
Diisobutylphenoxyethoxyethyldimethyl-benzylammonium Cl	100	100	100	64	20	2	Hyamine 1622 Rohm & Haas
Diisobutylcresoxyethoxyethyldimethyl-benzylammonium Cl	100	100	100	100	24	0	Hyamine 10X Rohm & Haas
Lauryldimethylbenzylammonium Cl	100	100	64	46	8	0	Triton K 60 Rohm & Haas
Octadecylidimethylethylammonium Br 85 parts Octadecenyldimethylethylammonium Br 15 parts	100	100	100	100	100	28	Octimet Fairfield Lab.
Alkyldimethyl-3,4-dichlorobenzylammonium Cl 5 parts Alkenyldimethylethylammonium Br 1 part Linolyldimethylethylammonium Br 45 parts	100	100	100	74	34	0	Tetrosan 60% Onyx Oil & Chemical Co.
Oleyldimethylethylammonium Br 35 parts Stearyldimethylethylammonium Br 10 parts Cetyldimethylethylammonium Br 10 parts	100	100	100	100	98	40	Ethyl Decab Fairfield Lab.

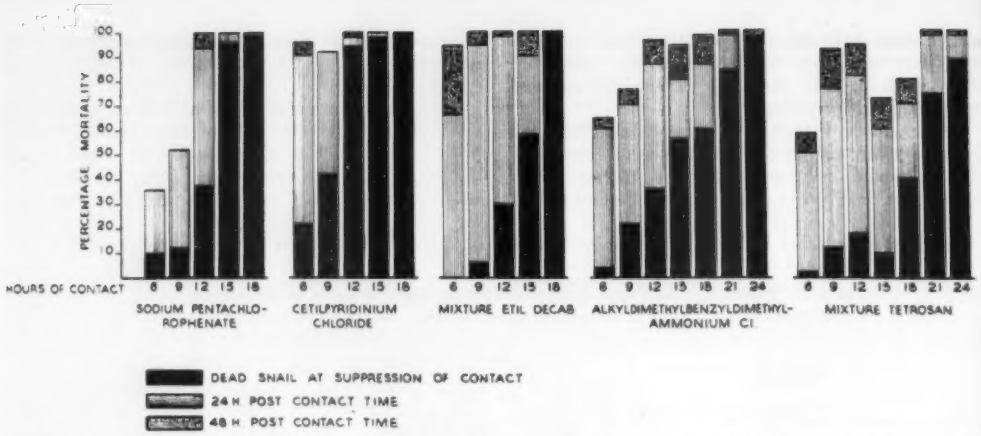

FIG. 1. Rapidity of action and retarded effect of 10^{-5} concentration upon *Australorbis* sp. snails 24 and 48 hr after suppression of effecitve contact time.

represents the percentage of dead snails checked after 48 hr of contact, discarding the live ones after removal from the test solution and extending the control of snails supposed dead over a period of 72 hr before recording.

With every chemical presented in Table 1 we analyzed the rapidity of action and the retarded effect of 10 ppm concentration of the active drug in tap water, and placed 50 snails simultaneously into each test flask. The snails remained in contact with the solutions for 6, 9, 12, 15, 18, 21, and 24 hr, respectively. After withdrawal from contact, the live ones were washed in soft running water, separated from the dead specimens, and placed in fresh tap water in separate flasks. The live snails were examined 24 hr later in order to separate and to count those that had died during this period. The same procedure was repeated after 48 hr.

Figure 1 shows results obtained with the more and the less active simple and mixed drugs. These results show that some quaternary ammonium compounds have the same or greater rapidity of action than sodium pentachlorophenate, and that with the majority of these compounds the retarded effect is great, with less time of effective contact with the active solutions. These preliminary results emphasize the potential importance of quaternary ammonium compounds in the destruction of the intermediate host of *Schistosoma* and suggest that drugs of higher activity can be found by more extensive research in compounds of that type.

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The Living Out of "Future" Experiences Under Hypnosis[1]

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In hypnotic regression, the subject seems to relive experiences and memories of earlier times. If a hypnotized subject is told he is 5 yr of age, or that it is the afternoon of October 16, 1940, he will behave in a way appropriate to that age or time as if it were the present. This technique has been modified in a number of ways for therapeutic purposes, especially in the treatment of combat neuroses. It has theoretical implications of major concern to the psychologist and psychiatrist.

Psychologists have attempted to validate the phenomenon by the administration of projective and intelligence tests to hypnotically regressed subjects. For example, Bergmann *et al.* (*1*) regressed a soldier to alternate ages from 3 to 20. At each level, they gave him the Rorschach and reported that the test findings were representative of that age, showed the dynamics of that period, and did not reflect any experience subsequent to the suggested age level. Orne (*2*), however, in a study of ten university students to whom the Rorschach was administered during hypnotic regression to age 6, found no consistent changes in the test results and concluded that there was no evidence of true or complete regression, the personality actually remained adult.

Those who have studied hypnotic regression and noted the dramatic way in which the subjects relive their past experiences have offered this as a proof of its validity. It has remained a proof against which no contrary evidence has been offered.

One of us, as an undergraduate, discovered to his

[1] This work was made possible by a grant to the Department of Psychiatry, Yale University, from the Foundation's Fund for Research in Psychiatry.

surprise that hypnotized subjects were able to live out experiences appropriate to a suggested date in the future as well as in the past. Kline (*3*) has described the administration of psychological tests to subjects to whom advanced ages were suggested, and he felt that their performances on these tests were appropriate to these age levels. It occurred to us that, if a hypnotic subject could vividly live out and describe in great detail the events of a "future" time suggested to him, this experience could cast doubt on the validity of hypnotic regression to a time in the past. If "progression" is a fantasy, maybe regression is also a fantasy.

We have been working with a group of five easily hypnotized subjects, all of whom are capable of deep hypnosis with amnesia in which they are able to relive vividly past experiences. We find that all our subjects consistently and without exception are also able to live out "future" experiences when an age or date is suggested to them under hypnosis. For example, a medical student is told while he is in hypnosis that it is the afternoon of a day in October, 1963. The experimenter then asks:

Where are you now?

(Sighs) I'm pretty busy, got an emergency case that just came in—abdominal obstruction. This one's pregnant too, lot of complications. And we're in her abdomen right now. And I just don't have too much time to talk. (Describes patient's abdominal cavity.) I managed to get this diagnosis, which I was pretty happy about. (Describes presenting symptoms of patient and the resultant diagnosis.) It's mostly adhesions—a number of adhesions especially down in the lower right quadrant. Think all we have to do is go ahead and release these adhesions, but we found two spots in which there was a definite obstruction.

You did a good job of diagnosing this.

Yeah. I was kinda glad to hit the diagnosis. (Describes similar cases encountered in 1958; shifts back to description of operation.) No ulcer. Close her up! Oh, she'll be all right.

All of our subjects live out "future" events in their lives with equal verisimilitude to their accounts of the past. Their futures sound possible and well within the realm of probability, as judged from a careful personality study made prior to this investigation. Our subjects did not attempt to describe events outside their own lives, except in a most vague fashion. Their accounts of the future frequently contradicted their present plans and daydreams and sometimes include conflictual and traumatic experiences. For example, one subject, told that it was a late afternoon in October, 1963, portrayed her grief at the recent death of her 3-month-old son.

We believe that each of our subjects, to please the hypnotist, fantasied a future as actually here and now. We suggest that many descriptions of hypnotic regression also consist of confabulations and simulated behavior. We suspect, however, that our doubts do not apply to the reenactment of traumatic past experiences; that is, we feel that there is a great difference between asking a subject "regressed" to the age of 10 to describe a relatively uneventful day and his spontaneously dissociating and reexperiencing the death of his father under tragic circumstances (*4*).

We are now engaged in investigating this phenomenon. In addition to its relevance to hypnotic regression and to the whole problem of memory, we feel that it offers us a method of studying fantasies and daydreams and all the facets of personality evoked by a projective technique.

Summary. We have observed an experience that has been regularly elicited in a group of hypnotic subjects. This consists in their living out and describing the events of a future date or age suggested to them. We believe that this challenges the validity of hypnotic regression to a nonconflictual time in the past.

References and Notes

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2. M. T. Orne. *J. Abnormal Social Psychol.* **46**, 213 (1951).
3. M. V. Kline. *J. Genet. Psychol.* **78**, 195 (1951).
4. M. H. Erickson. *Arch. Neurol. Psychiat.* **38**, 1282 (1937). This is a remarkable account of a patient who regressed to, and lived out, an amnesic experience in which he developed apparent unconsciousness from a beating and possible narcosis, which Erickson was later able to document from hospital and police records of that time.

Received February 8, 1954.

Communications

Sex Ratio and Parental Age

M. E. Bernstein, in *Science* **118**, 448 (1953), criticizes an article by the present writer that appeared in an earlier number [*Science* **117**, 531 (1953)]. The conclusion in my note was simply that the well-known change in sex ratio with increasing age of the parents could be attributed to the change in age of the father, the data indicating a linear relationship between the two. Her criticisms include the following points: (i) that the data are not linear; (ii) that there is a similarity between abortion rate versus age curve and sex ratio versus age curves; (iii) that the ages of husband and wife are positively correlated; and (iv) that the data were unstratified and that data of hers from the "upper social strata" show no such age effect.

Of these objections, the third would be most serious if it were valid. Of course, the ages of husband and wife are positively correlated, and it is for just this reason that partial regressions were used. This method allows for the correlation mentioned and leads to the conclusion that, in our data, the age of the father is more directly related to the variation of sex ratio than the age of the mother. It is not true that Ciocco denies this possibility; he is correctly quoted by Bernstein as writing that his data "cannot be used to support any such conclusion." The later extensive data in my article

do offer substantial support. Furthermore, two other methods had been used to remove the correlation between the ages of spouses, in order to check the result from the regression analysis. One of these, the path coefficient method of Wright, was explicitly mentioned.

It is charged that the data are not linear. This is not true. The data are linear in the only sense in which data can be said to be linear: the deviations from linearity are not statistically significant (despite the large sample size of more than 9 million births). However, it can be assumed that when more extensive data become available, the change in sex ratio with age, like biological phenomena in general, will prove to involve some nonlinear component. This may then be considered a logical extension and refinement, but hardly a refutation, of the linearity reported in my communication.

It is possible that differences in abortion rates contribute to the trend, even though Ciocco, whom Bernstein cites in another connection (see above), concluded that this cannot be the only factor [*Human Biol.* **10**, 36 (1938)]. No opinion was expressed on this question in my article.

No age effect of the approximate magnitude of that reported in my article, a decrease of seven male births per 10,000 births per 5-yr increase in age of the father, could possibly be demonstrated in the numerically small sample obtained from a 1935 German "Who's Who" and Radcliffe College Alumnae by Bernstein, despite the interest of her sample in other connections. However, I agree that the effects of different strata on results obtained from an analysis of combined data constitute an important and troublesome problem, one that should be circumvented where possible. Because of the great difficulty of obtaining sufficiently extensive selected data for testing the effects of parental age on sex ratio, it seems worth while to obtain as much information as possible from data that are actually available.

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Received January 26, 1954.

Owing to an editorial oversight, Dr. Novitski unfortunately was not given the opportunity to see Marianne E. Bernstein's communication prior to its publication.

Geologic Controls of Lead and Zinc Deposits in the Goodsprings (Yellow Pine) District, Nevada

Lead-zinc ore of the Goodsprings (Yellow Pine) district typically occurs as flat pipes and tabular bodies replacing dolomitized limestone in zones of fracturing and brecciation. About 98 percent of the combined lead and zinc output has come from one formation, the Monte Cristo limestone of Mississippian age, which averages only 700 ft in thickness. Of the five members into which this formation has been subdivided—the Dawn limestone, Anchor limestone, Bullion dolomite, Arrowhead limestone, and Yellowpine limestone, named in ascending order—the Anchor and Yellowpine have been most productive, the latter having accounted for about 85 percent of the production. Because of the irregular surface of the unconformity separating the Monte Cristo limestone from the overlying Bird Spring formation of Pennsylvanian age, the Monte Cristo varies in thickness and, in some places, one or more of its members are missing.

The areal distribution of ore bodies is related to a complex pattern of faulting. The terrain is divided by thrust faults into imbricate blocks from 1.5 to 3 mi thick. These faults trend generally with the strike of the beds, but in most places their dip exceeds the dip of the bedding. Blocks bounded by the principal thrusts are intricately broken by smaller thrusts and high-angle faults, many of which apparently represent rifts and tears. Reefs of breccia border many faults, but the effects of brecciation and fracturing vary with the character of the beds involved. Massive limestone yielded to deformation largely by fracturing; thin beds, more by gliding and flowage. Thus, the Monte Cristo limestone, a comparatively massive unit between thinly bedded units, is complexly fractured at many places where the overlying Bird Spring formation remains relatively intact.

Chiefly because of this fracturing, the Monte Cristo limestone became the host for most of the ore bodies. Results of detailed studies of 17 mines suggest that the mineralizing solutions rose along conduits opened by intersection of faults and joints, or by differential movement along arcuate faults. Locally, the breccia along the feeding fissures was mineralized; more commonly the ore formed in permeable ground marginal to the fissures. The high permeability of the Monte Cristo limestone favored lateral spreading of fluids and sulfide replacement of limestone or dolomitized rock. In some places, the paths of maximum permeability were partings between beds or sandy fillings in old caves; more commonly they were zones of fractured ground along flexures or faults. Relatively impermeable bodies of mudstone and altered porphyry, as well as films of clayey gouge along thrust planes, locally contributed to the formation of ore by retarding upward progress of fluids.

Beneath some of these impermeable caps, the ore remains unaltered and consists principally of galena and sphalerite. In most places, however, the ore is oxidized to undetermined depths below present mine workings. Sphalerite has been altered to hydrozincite and calamine. Locally, the galena has also been altered —to cerussite or less commonly to anglesite—but mostly it remains as scattered pods and lentils in the oxidized ore. This common association of the primary lead sulfide with the secondary zinc carbonate and silicate indicates that the oxidation of primary ore was accomplished without significant change in position or shape of the ore bodies.

Prospecting in the district was begun in 1857. The

peak of production was reached during World War I; after 1928, the district was virtually dormant until the outbreak of World War II. At the end of 1944, the output had reached a total of 93,000 tons of lead and 37,000 tons of zinc. By 1943, however, three out of every four lead-zinc properties in the district were too nearly exhausted to be productive, and the total production of lead and zinc together for 1943 and 1944 was less than 10,000 tons.

Although many ore bodies end downward in zones of high-angle faults, very few faulted continuations of the ore bodies exist because most of the faults are older than the ore. Prospecting should search along the conduits—either above or below ore bodies already mined.

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U.S. Geological Survey
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Received March 16, 1954.

Landslide Investigations along the Columbia Valley in Northeastern Washington

Landslides occur in the surficial deposits along the upper Columbia River Valley with such great frequency that their consideration has become an important factor in relation to engineering developments and land utilization. Geologic investigations have been in progress since 1942 in an effort to develop criterions for predicting the probable amount of land that will be affected by sliding. The area of studies extends along the upper 200 mi of the Columbia River Valley in the state of Washington, reaching upstream from Grand Coulee Dam along Lake Roosevelt to Canada and downstream from Grand Coulee Dam along the Columbia River nearly to Chief Joseph Dam. Numerous fresh landslides in a relatively uniform physical setting present an unusual opportunity for a study of geologic processes and for a statistical analysis of landslide data. The application of statistical methods is believed to be a new approach to the study of landslides and the stability of natural slopes.

Early examinations revealed a wide variety in the size and shape of slides, and these differences seemed to reflect the particular geologic setting. Preliminary studies, however, were inconclusive on why a slide would occur in one place and not in another, and on why a slide would cut deeply into one terrace and shallowly into another. Comprehensive research was begun in 1950 to determine the factors underlying these apparent differences.

Investigations consisted of studies and measurements of more than 300 landslides in the Nespelem silt of Pleistocene age. Slides were classified into type groups, so that each type might be analyzed and compared with the others. The geologic environment was subdivided into the classification factors—material, ground water, terrace height, drainage, original slope, submergence, culture, and material removal. These factors were subdivided into quantitative or qualitative categories that could be determined by field examinations.

Elements of the geometric configuration were measured and analyzed with relation to the classification units in important type groups. For the purpose of this study and its practical significance, the key measurement of a landslide has been conceived as the ratio HC/VC, where HC and VC are, respectively, the horizontal and vertical distances from the foot to the crown of the landslide taken at midsection normal to the slope. Of the eight classification factors analyzed by statistical methods, only material, ground water, original slope, and submergence proved to be significantly related to the HC/VC-ratio. By using the various categories of each of these factors, a formula has been developed for predicting the HC/VC-ratio of landslides, thus providing the geologist with a new method of estimating the amount of land that may be affected by impending landslide action in a geologic setting similar to that of the Columbia River Valley.

The stability of natural slopes is being investigated by combining classifications and measurements of slopes on which slides have not occurred with those on which slides have occurred. The analysis includes the variable factors—material, ground water, terrace height, original slope, and submergence. This technique of geologic classification and statistical analysis may be considered a new tool to assist geologists and engineers in estimating whether natural slopes are relatively stable or unstable.

A report describing this work is in preparation. The next phase of the investigations will test the practical application of the slope stability technique and the formula for prediction of the HC/VC-ratio of landslides.

Fred O. Jones

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Received March 16, 1954.

On "Audiogenic Seizure and the Adrenal Cortex"

The interesting paper by W. P. Hurder and A. F. Sanders, "Audiogenic seizure and the adrenal cortex," *Science* **117**, 324–326 (1953), is unfortunately marred by a faulty analysis of variance and an unsatisfactory interpretation of that analysis, leading to conclusions which are unjustified and largely erroneous.

By using their published treatment means and standard deviations, a correct analysis of variance can be constructed. It appears in Table 1, in different units and after correction of various errors.

The analysis of variance shows (1) some indication that there is an interaction of all three factors together, (2) a "significant" interaction of test and susceptibility, (3) "highly significant" interaction of

TABLE 1. "Correct" analysis of variance of data reported by Hurder and Sanders.

Source		df	Sum of squares	Mean square	Variance ratio	p
ACTH	(A)	1	249	249		
Test	(T)	1	2	2		
Susceptibility	(S)	1	215	215	10.0	0.01 –
A × T		1	263	263	12.3	.001 –
A × S		1	1	1		
T × S		1	86	86	4.0	.05 –
A × T × S		1	67	67	3.1	.1 –
Within groups		72	1540	21.4		

ACTH and test, and (4) a "highly significant" main effect of susceptibility if the test-susceptibility interaction is considered to be merely a result of sampling variation. Hurder and Sanders concluded that ACTH, susceptibility, and the three-factor interaction were "highly significant."

The erroneous analysis of variance evidently resulted from errors in computing sums of squares for the various interactions. Such errors could have been detected by noticing that the two-factor interaction mean squares are significantly small compared to that for three-factor interaction. This could be a chance result, but will usually lead to detection of errors in arithmetic.

Several biological questions are raised by the correct analysis of these data. Probably the least is whether susceptible animals have larger adrenals than nonsusceptible animals, or whether a difference develops in a few days after audiogenic seizure. The lack of an ACTH effect (in a few hours) on adrenal weight in untested animals is concordant with the present state of knowledge, so far as I am aware. Hence there might be considerable interest in learning how ACTH could affect adrenal weight of animals subjected to seizure tests, remembering the short time in which it could act (20 hr from first injection to death, and only 10 hr from seizure test to death). Lastly, there is the question of how the seizure test can cause a decrease in adrenal weight, a result that appears discordant with other knowledge of such phenomena. Perhaps Hurder and Sanders are already at work on these questions.

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Received November 20, 1953.

A Correction and Additional Observations

INTERPRETING the revised analysis by H. W. Norton, we regard the interaction between seizure test and ACTH as the only statistically significant interaction. The sequence, audiogenic seizure (hereafter designated AGS), ACTH, final AGS, was peculiarly effective in increasing adrenal weight. Reference to the table in Norton's communication reveals that ACTH alone did not produce a significant increase in gland weight, when the ACTH effect is evaluated in the light of the interaction of ACTH and seizure test. It will further be noted that the variation in adrenal weight attributable to AGS susceptibility is statistically significant. This is as reported in the original article.

A study that introduces data relevant to the present interpretation of our first research has now been completed in our laboratory by W. J. McGovern and will soon be published. In this experiment, 56 40-day-old hooded rats were classified as AGS-susceptible or nonsusceptible, and then further divided into subjects receiving ACTH injections for 5 days (6 mg standard ACTH per day) or receiving equivalent water injections. All injections began 4 days after the initial AGS test, and animals were retested for AGS susceptibility on the 5th day of injection. Except for these details, the procedures of this experiment were the same as those of phase A of the original study.

The 5-day ACTH regimen produced no significant change in AGS incidence. The adrenal glands of these rats were removed 10 hr after the last AGS test. The percentage body weights of these glands are presented in Table 1, for comparison with similar data from the rats of phase A of the original study.

TABLE 1. Means and standard deviations of percentage body weights of adrenal glands.

	Susceptible			Nonsusceptible		
	Mean	S.D.	N	Mean	S.D.	N
ACTH-6 mg	0.0405	0.0037	10	0.0331	0.0050	10
Water	.0313	.0042	10	.0280	.0027	10
ACTH-30 mg	.0373	.0057	14	.0303	.0037	14
Water	.0280	.0046	16	.0278	.0059	12

An analysis of variance of these new data indicates that the interaction of ACTH and susceptibility is statistically significant (1-percent level). Neither ACTH nor susceptibility *alone* is a significant source of adrenal weight variation, although the ACTH means are larger than their control means and the susceptible means are slightly larger than their control means. A striking similarity ot the relations among the means of the rats of this study and those of the rats of phase A of the first study is apparent in Table 1. In the absence of a phase B in the 5-day ACTH experiment, we cannot extract from the data the effect of the final AGS. It is our guess that this interaction of ACTH and susceptibility with extended ACTH injections is another instance of the effectiveness of the AGS, ACTH, AGS sequence in increasing adrenal weight. However, neither of these researches permits an answer to the question whether a sequence of ACTH, AGS might not be sufficient to produce a significant increase in adrenal weight.

Our first report raised, but did not answer, the question whether the significantly large adrenal glands of rats susceptible to AGS preceded or followed AGS.

The data of the 5-day ACTH study suggest an answer. Were susceptibility, independently of any immediate effect of the seizure, associated with heavier adrenals, one would expect to find evidence for this in the 5-day ACTH study.

We are grateful to Dr. Norton for having called our attention to an error that had actually reduced the amount of information available in the raw data of our original research.

WM. P. HURDER
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Received February 17, 1954.

Water Resources of the Louisville Area, Kentucky and Indiana

A study recently made by the U.S. Geological Survey indicates that the potential water supply from both surface and ground-water sources in the Louisvills area, Kentucky, is more than sufficient for present needs.

Use of water in the Louisville metropolitan area for all purposes amounted to 765 million gallons per day (mgd) in 1952. Of this amount, 34 mgd came from wells and 731 mgd was withdrawn from streams. Of the 731 mgd, 659 mgd was untreated Ohio River water used by industries for cooling.

In certain parts of Louisville where ground-water supplies are being used, the present use of about 30 mgd could be increased only slightly. However, northeast of Louisville, about 280 mgd of ground water could be developed in a 6-mi strip along the river between Harrods Creek and Zorn Avenue. This water, if developed, would be induced infiltration from the river and would be suitable for industrial or domestic use.

Southwest of Louisville, the water available in sand and gravel deposits is about 12 mgd, and about 40 mgd could be developed in addition by induced infiltration from the river. Although detailed information is not available for the Indiana side of the river, additional supplies can probably be developed near the river northeast of Jeffersonville. The area north of Utica Pike is not considered favorable for development of large quantities of ground water, because of the high elevation of the bedrock.

Water from wells in the sand and gravel is of better quality than water from wells in the limestone. The average hardness of water from 15 wells in limestone that have been sampled annually since 1944 is 580 parts per million (ppm). In 1952, the average hardness of water from wells in sand and gravel was 475 ppm. The quality of the water in the sand and gravel is affected by the type of underlying bedrock. For example, water from sand and gravel over the limestone is harder than water from sand and gravel overlying shale.

The daily flow of the Ohio River at Louisville will drop as low as 2600 mgd on the average of once in 20 yr. Present use is 730 mgd, or 29 percent of 2600 mgd. Most of the water is returned to the river and is available for reuse downstream.

The river will reach a stage of 445.5 ft above mean sea level at the upper gage at dam 41 on the average of once in 20 yr. Normal pool stage is 420 ft. Most floods occur in the 4-mo period January through April, and all high floods have occurred during those months.

Considerable variation in the chemical quality of Ohio River water at Louisville is caused by changes in volume of flow, industrial and domestic pollution, and other factors. Ohio River water at Louisville is moderately hard. During 1952, the hardness ranged from 270 to 58 ppm, and averaged 119 ppm.

The small streams in the area are not important as major sources of water; however, Harrods Creek and Pond Creek are each capable of supplying about half a million gallons per day.

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U.S. Geological Survey
Louisville, Kentucky

Received March 16, 1954.

Zoological Nomenclature

NOTICE is hereby given that the International Commission on Zoological Nomenclature has under consideration the following case involving the possible use of its Plenary Powers: *Caenisites* Buckman, 1925 (Class Cephalopoda, Order Ammonoidea), proposed suppression of. Full particulars of this case are given in part 12 of volume 6 of the *Bulletin of Zoological Nomenclature*.

Any comments should be sent to me as soon as possible and, in any event, should be dispatched in time to reach this office not later than August 26, 1954, when voting on this case will begin.

FRANCIS HEMMING
Secretary to the International Commission on Zoological Nomenclature

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Received March 1, 1954.

Structural and Igneous Geology of the La Sal Mountains, Utah

Part of the effort of the U.S. Geological Survey is devoted to such basic questions as the ultimate source of the metals contained in mineral deposits. The search for new deposits and for extensions of old ones would be greatly facilitated if we understood the source of the metal and why it happened to be deposited where we find it. Basic questions of this sort prompted the decision to map and study the structural and igneous geology of the La Sal Mountains.

The La Sal Mountains include three of the 15 laccolithic mountain groups on the Colorado Plateaus. These 15 centers of igneous activity seem to represent

a single intrusive process—one that operated under very similar physical and chemical environments but was arrested in a different stage of development at each mountain. This concept suggested the desirability of mapping all the laccolithic mountains on the Colorado Plateaus to obtain working models illustrating the different stages in the igneous and mineralizing process.

These geologic problems fundamentally are physicochemical; but whereas the chemist deals with volumes that can be placed in a test tube, the geologist is confronted with volumes measurable in cubic miles. In the laccolithic mountains, the systems involve volumes ranging from 2½ to more than 9 mi^3. The spatial relationships, chronology, and changes in environment of such mountainous volumes are determined not by weights and measures but by surveying.

The mapping and related studies indicate that the earliest intrusions at each of the mountains were physically injected masses of diorite porphyry in the form of stocks and laccoliths. The degree of induration of shale at the contacts of these intrusions and the alteration of coal xenoliths incorporated in them indicate that the temperatures of the melts were only about 500° C. The physical injection of these intrusions produced large domes around the stocks and anticlines over the laccoliths that were pushed out radially from the stocks. Middle La Sal Mountain and several of the other laccolithic mountains on the Colorado Plateaus did not progress beyond this stage.

After about 5 mi^3 of diorite porphyry had been emplaced, the composition of the intrusive melt became monzonitic. Between 1 and 2 mi^3 of monzonite porphyry was intruded. Its temperature and mode of emplacement were approximately the same as for the diorite porphyry.

During the monzonite porphyry stage, there was little alteration of the wall rocks; apparently the dioritic and monzonitic intrusions not only were cool but contained only minor quantities of volatiles. At South La Sal Mountain the igneous activity ended with this stage.

At North La Sal Mountain, however, the igneous activity did not end with this stage. The monzonite porphyry there was followed by intrusion of a dike-swarm complex of dominantly syenitic rocks, a series of feldspathoidal dikes, and an irregular stock of soda syenite. The earliest of these syenitic intrusions seem to have been emplaced by physical injection, but the later ones melted and assimilated some of the adjacent wall rocks and caused other parts of the walls to recrystallize. The surrounding country rock, including many of the earlier intrusions, became shattered by radially arranged zones of vertically sheeted joints. Hydrothermal solutions escaping from the syenitic intrusions by way of these fissured zones deposited gold-bearing sulfides in them.

At this stage in the history of the North La Sal Mountain, the roof over the instrusions became breached, and explosion breccias developed in four major pipelike masses and in several lesser ones. These explosion breccias undoubtedly mark the roots of volcanoes. Associated with the breccias are intrusions of aegirine granite and soda rhyolite. These intrusions are much richer in potash than the earlier ones, and they contain the form of quartz that indicates a temperature about 600° C. This temperature is higher than that indicated for the diorite and monzonite porphyries, but when the breccia pipes were formed the pressure conditions drastically changed; breaching of the surface and resultant volcanism could have caused retrograde boiling. The igneous activity at North La Sal Mountain ended with this stage.

Radioactivity in the La Sal Mountain intrusions appears to be related to the magmatic differentiation sequence and not to the hydrothermal activity. The radon is least in the dioritic intrusions, greatest in the syenitic ones, and seemingly not affected by differences in degree of hydrothermal alteration. The other metals —copper, lead, zinc, selenium, and presumably the gold and silver—are of hydrothermal origin. They are mostly in the zones of vertically sheeted joints, and mostly in the most altered parts of those zones.

CHARLES B. HUNT

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Received March 16, 1954.

Germanium Oxide-Titanium Phosphate Glass[1]

DURING the course of studies of various materials of possible use in delivering interstitial radiation by use of P-32 preparations, it was found that fusion of GeO_2 and $Ti_3(PO_4)_4$ produced glasslike melts. On increasing the Ti content, there was a marked decrease in the solubility, so that fusion of a mixture of 50% GeO_2-50% $Ti_3(PO_4)_4$ produced a stable glass, insoluble in water.

The $Ti_3(PO_4)_4$ was prepared by treating sirupy H_3PO_4 (95%) with concentrated HCl (37%) containing equivalent $TiCl_4$. The reaction mixture was heated to dryness, extracted with water, dried, ground to pass 100 mesh, and mixed with an equal weight of GeO_2. The resulting mixture was fused in an Alundum crucible at 1300° C (Pt-wound furnace). The viscosity at this temperature permitted easy pouring or drawing. A brown glass was produced that was annealed for 2 hr at 500 to 800° C and cooled with the furnace.

The brown color may have been due to some impurity in the $TiCl_4$ or to elemental Ge or Ti. The depth of the color increased as the Ti content was increased.

A study of the optical transmittance of a sample of 50% GeO_2-50% $Ti_3(PO_4)_4$, fused cast and annealed as previously indicated, is shown in Fig. 1 (data from the Naval Research Laboratory, Washington, D. C.). These findings show that in the range 0.5 to 2.7 microns, the transmittance is approximately 80%. Be-

[1] The opinions or conclusions contained in this report are the author's and do not necessarily reflect the views or endorsement of the Navy Dept.

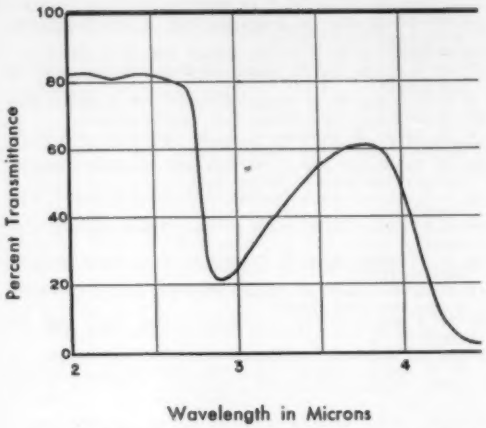

FIG. 1. Transmittance of 50% GeO_2-50% $Ti_2(PO_4)_4$ glass.

cause of the ease with which the melt can be cast, drawn, or pressed at temperatures of 1000 to 1300° C, a glass of this composition might be useful for infrared optical systems.

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Received January 6, 1954.

The Enzymes of Uridine Polyphosphates

IN response to the recent "News and Notes" report in *Science* about 5-uridylic acid compounds (*1*), which covered work appearing as late as Nov. 1953, it might be of interest to add the following supplementary information. In 1952 we described the mode of action of a yeast enzyme that was found to catalyze a pyrophosphorolysis of uridine-diphosphoglucose (UDPG), forming uridine triphosphate (UTP) (*2*). In *Biochimica et Biophysica acta* (Warburg volume) a more detailed description of this type of enzyme and of the UDPG pyrophosphorolysis was presented (*3*). In a series of articles from our group (*4, 5*) the first accounts of the isolation, properties, and enzymic reactions of UTP were outlined. The new triphosphate was found to be much more acid stable than ATP. Moreover, it was found that the enzymology of UTP differs strikingly from that of ATP. Thus, ionophoretically purified ITP and chemically synthesized UTP (*6*) does not serve as a phosphoryl donor for creatine and glucose in the presence of the corresponding "kinases" (*6, 7*). However, the same authors have found that a newly discovered enzyme, nucleoside diphospho kinase, called "nudiki" (*6, 7*), catalyzes the transfer of the terminal phosphate groups between adenosine-, inosine-, or uridine polyphosphate compounds. In this way Berg and Joklik found that ionophorized inosine triphosphate ITP (*8*) and UTP need adenosine disphosphate (ADP) in order to serve as phosphoryl donors of glucose in enzyme systems with nudiki present and adenylate kinase absent.

Based on these facts, we have developed specific and quantitative micromethods for UTP and UDPG. Our studies of the effect of UTP on the myosin system are as yet unpublished. The writer has, together with Szent-Györgyi's group (*9*), studied the effect of heavy meromyosin on UTP. UTP was found to be dephosphorylated at a rate higher than ATP. Likewise Kielley and the author (*10*) have found that crystalline myosine catalyzes a rapid dephosphorylation of ionophorized UTP to UDP which is 3 to 6 times faster than that of ATP. The dephosphorylation of ATP to ADP is actually proceeding with an appreciable rate only in the initial phase (*10*). This peculiar difference in kinetics between UTP and ATP is under investigation. Some of these observations may have interesting bearings, since a group at the University of Lund recently has found that UTP occurs in muscle (*11*). The frequent occurrence of both triphosphates as well as of nudiki makes it difficult to interpret whether effects of UTP like contraction of muscle fibers or phosphorescence of firefly extracts are primary effects or secondary effects through the ATP system. UTP (synthetically as well as enzymatically made) is able to serve as a "uridyl" donor for α-glucose-1-phosphate (Cori-ester) in the enzymatic back-reaction catalyzed by the UDPG pyrophosphorylase (*4, 5*). In this peculiar reaction ATP is inactive. The equation, UTP + α-G-1-P ⇌ UDPG + PP, in which α-G-1-P signifies the Cori-ester and PP inorganic pyrophosphate, summarizes the aforementioned facts. By this reaction, plus the transphorylation from ATP, UDPG can be regenerated from the uridine diphosphate (UDP) formed in the novel types of disaccharide synthesis discovered by Luis Leloir and his group (*12, 13*).

In the most recent discovery in the series of brilliant research studies performed by Leloir and his colleagues, it was found that UDPG can serve as a glycosyl donor in a highly efficient synthesis of sucrose, catalyzed by an enzyme present in germinating peanuts and beans (*13*). This and the trehalose phosphate synthesis (*12*) constitute two examples in which nonreducing disaccharides are formed in an efficient fashion, using UDP-glucose as a glycosyl donor. Leloir and Cabib (*12*) found that the equilibrium, catalyzed by the sucrose forming enzyme, is displaced greatly in favor of the disaccharide (UDP-glucose + fructose ⇌ sucrose + UDP). This may imply that the ΔF of hydrolysis of the α-glucose-1-phosphate linkage of UDPG is higher than that of free Cori-ester by a factor of 1500 to 3000 calories at *p*H 7. It remains to be seen whether the only way by which the living cell can efficiently recharge UDP involves the uridyl-transferase plus the UDP-kinase. It should be added that our group, in collaboration with G. T. Mills, has found that uridyl-transferases occur in the cell nuclei of rat liver and that these enzymes are active, not only on UDP-glucose, but also can form UTP from other UDP-glycosyl compounds (*14*). The recent studies by Rutter and

Hensen (*15*) at the University of Illinois indicate that UDPG may play a role in the formation of adaptive enzymes initiating galactose metabolism, a problem that was posed by the author of this article at the meeting last June at the McCollum-Pratt Institute, when discussing mechanism of enzyme action (*16*).

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Book Reviews

The World of Primitive Man. Paul Radin. Henry Schuman, New York, 1953. 370 pp. $5.00.

Dr. Radin always has approached the data of anthropology in his own unique manner, irrespective of the fashion of the moment, and he has seldom failed to be provocative. In this respect, his new volume is as characteristic of him as any of his earlier books and monographs. At a time when anthropologists and other social scientists have felt the need of being more discriminating in their vocabulary, Radin says: "I employ the words *culture, civilization,* and *society* interchangeably and also the phrases *primitive civilization* and *aboriginal civilization* interchangeably." And, when concepts used in the analysis of kinship systems and social organization are undergoing refinement, "classificatory" and "clan" are generalized according to his own conceptions. The latter, he writes (p. 193), "in spite of all the attacks that have been made upon its ubiquity, particularly by American anthropologists, is clearly the fundamental form the social-political organization of primitive people assumed."

The central problem that concerns the author is continuous with his discussion of *Primitive Man as Philosopher* (1927) and some passages of this earlier volume, with only minor changes, occur in *The World of Primitive Man.* For some reason or other, Radin entertains the notion that "few anthropologists, at bottom, have been willing to admit that primitive man was ever effectively guided by rationalistic or realistic considerations in the attainment of his goals" (p. 194). Without minimizing the role of magical beliefs and practices, he wants to demonstrate that there has been less interference "with the orderly processes of life" and processes of "rational and objective thinking" from these sources than has been supposed. In consequence, the author believes it can be shown that prior to, and apart from, the great civilizations (Egyptian, Babylonian, Indian, Chinese, and Greco-Roman) aboriginal civilizations developed at least three positive features that, in contrast with what we find characteristic of the former seem "at first blush" almost "semi-perfect." These are (p. 11): "the respect for the individual, irrespective of age or sex; the amazing degree of social and political integration achieved by them; and the existence there of a concept of personal security which transcends all governmental forms and all tribal and group interests and conflicts." In none of these aboriginal cultures, Radin says, "did those basic economic distortions and crises arise that have existed in all the major civilizations since 3000 B.C." And, in the primitive cultures, too, the myth of the after-life was more poorly developed, "there was no devaluation of life on earth"; on the contrary, "man's most insistent plea was that he be allowed to return to the earth." In other words (pp. 7–8), "instead of life on earth being regarded as an insignificant incident" as we find in the great civilizations, in the aboriginal cultures, "just the contrary held true; life in the after-world was so interpreted."

Radin espouses a stimulating thesis, but it is doubtful whether most anthropologists will be immediately convinced without more evidence than the author presents in this book. His ethnographic erudition is not in question, but he strides through the literature with seven-league boots, documenting his generalizations from a few selected cultures and quoting at length from source material. Nevertheless, the question remains whether his selected examples are representative of the primitive world at large and whether more systematic and detailed comparisons are not in order. Radin thinks primitive peoples have something to teach *us.* After quoting the reflections of the Eskimo Anarulungua when he stood atop a New York sky-

scraper, the author closes his book with this message: "Nature is great, but man is greater still."

A. Irving Hallowell

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Structure and Mechanism in Organic Chemistry. C. K. Ingold. Ithaca, N. Y.: Cornell Univ. Press, 1953. 828 pp. Illus. $9.75.

Chemists have for many years owed a debt of gratitude to Cornell University for the series of monographs that have arisen out of the Baker Lectures. One important function served by these lectures, and by the resulting books, is that distinguished leaders in the different branches of chemistry are given the opportunity to set forth in considerable detail, and in a more systematic way than is possible in the journal literature, their own contributions to the science. This latest addition to the growing collection of definitive monographs is a worthy companion of its predecessors. Professor Ingold is to be both congratulated and thanked for this stimulating discussion of his outstanding work on reaction mechanisms. No chemist can afford to be ignorant of the material that is presented here.

An idea of the field that has been explored by the author can be most easily obtained from a list of the titles of the 15 chapters:

Valency and Molecular Structure; Interaction Between and Within Molecules; Physical Properties of Molecules; The Aromatic Nucleus; Classification of Reagents and Reactions; Electrophilic Aromatic Substitution; Nucleophilic Aliphatic Substitution; Olefin-forming Eliminations; Saturated Rearrangements; Unsaturated Rearrangements; Aromatic Rearrangements; Additions and Their Retrogression; Acids and Bases; Carboxyl Reactions; and Nucleophilic Aromatic Substitution.

As is evident from this list, reactions which proceed by free-radical mechanisms are almost completely ignored. This deficiency would of course be a serious one if the book were regarded as a comprehensive treatment of "structure and mechanism in organic chemistry"; it becomes of minor importance, however, when the book is instead regarded as what it actually is—a summary of the work of the author and of his colleagues. Similarly, the frequent failure to give due recognition to parallel, or even earlier, work of other investigators who have not been associated with Ingold is regrettable, but the value of the book as a survey of the author's own contributions is not thereby greatly decreased. It is, in fact, a tribute to the remarkable breadth of the author's interests that, even with this limitation, so large a segment of organic chemistry is covered.

Some features of *Structure and Mechanism in Organic Chemistry* will certainly be found irritating by a number of readers. The prose style is complicated and, especially in the initial chapters, makes comprehension difficult. The meaning is often obscured also by the use of many specially coined words, of which only a few like "electrophilic" and "nucleophilic" have as yet become generally familiar. Moreover, since the treatment of complex problems requires that a great many independent factors be considered, one not infrequently gets the unfortunate impression that a new effect is invented for the explanation of each new observation. Even though these criticisms doubtless have some justification, nevertheless, they do not seriously detract from the unquestionable excellence of this valuable and instructive book which is, in fact, both the best and the most easily readable presentation of Ingold's work that is now available.

G. W. Wheland

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Applied Electron Microscopy. Robert B. Fischer. Bloomington, Ind.: Indiana Univ. Press, 1953. 231 pp. Illus. $4.85.

Introduction to Electron Microscopy. Cecil E. Hall. New York–London: McGraw-Hill, 1953. 451 pp. Illus. $9.00.

According to the prefaces, both of these volumes are based on courses the respective authors have taught for several years, both courses are offered to seniors and graduate students of diverse interest and background in science, both authors state the same general objectives—and similarity terminates with these points. The contrasts between the two volumes impress me as a result of the authors' differing views as to the rigorousness with which they feel fundamental background needs to be developed.

The little volume by Fischer is so simply and nicely written that it can easily be perused in an evening. Comparisons of electron microscopy with the more familiar light microscopy are numerous. The few equations, not being developed, have to be taken on faith and seem to contribute little. Roughly half the volume is given over to specimen preparation and description of representative pictures (hence, I presume, the title); this is about the same amount of space as is given to these subjects in the considerably larger volume by Hall. It is difficult to see how the material given by Fischer can be stretched to fill the time of a college course or, without supplement, give a sound basis for the development of independent electron microscopists. The volume does seem to me to have real value, however, both for those seeking only a superficial appreciation of the subject, and for those who are in a position to collaborate with a competent electron microscopist and, hence, need only a simplified introduction.

The larger volume by Hall is a systematic account beginning with essential elements of physical theory and logically developing the subject step by step. He manages to work in a good many pages of mathematical exposition and documentation without calling for a background beyond the sophomore level of mathematics and physics. The present reviewer is one of those who finds the mathematical sections of most physics books overly abbreviated shorthand that can

be followed with difficulty if at all. Hall makes the reading easy not by the expedient of omitting rigorous development but by interpolating explanatory sentences between the mathematical steps. As the author says, he is "less concerned with providing the answers for passing emergencies than . . . in providing the means for finding answers in general." For this purpose, he gives first a rigorous background which should develop the ability to discuss problems (130 pp.), then he discusses current electron microscope construction (90 pp), then the nature of images obtained (80 pp.), then a detailed section covering most of the many methods that have been developed for preparing specimens (85 pp.) and, finally, gives some selected examples of studies that have been performed (35 pp.). The last section does not have the completeness of the preceding ones but the examples given are enough for illustrative purposes. The volume impresses me as an excellent textbook.

In summary, both books seem to me valuable additions to the literature but they are for different people and different purposes.

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Biochemical Preparations, Vol. 3. Esmond E. Snell, Ed. New York: Wiley; London: Chapman & Hall, 1953. 128 pp. $3.50.

Volume 2 of *Biochemical Preparations* appeared three years after the first volume, but the third volume was released about one year after the second. The style of the other volumes is followed. The methods include isolation from natural sources and syntheses by biological and organic methods. A large number of the preparations have been checked in the laboratory of the editor.

The preparation of two crystalline enzymes, muscle phosphorylase and ribonuclease is reported in detail, and the method for determining the former is included. The extractions of DPN from yeast and TPN from sheep liver and their purification by anion exchange chromatography are described. Pyridoxamine phosphate is prepared from the dihydrochloride and oxidized to pyridoxal phosphate. Protoporphyrin dimethyl ester is prepared from hemin. *d*-Isocitrate is prepared from the leaves of *Bryophyllum calycinum*, and *dl*-isocitric acid lactone from sodium succinate. Specific organisms are used in the synthesis of D- and L-lactic acids by fermentation, and L-citrulline from L-arginine. Enzymic preparations are used for the synthesis of sodium D- and L-isocaproate from D- and L-leucine, of D-glucose-6-phosphoric acid from the fructose derivative, and of L-kynurenine from L-tryptophan.

Organic synthetic methods are described for elaidic acid, 2,4-dinitrofluorobenzene, dihydroxyfumaric acid, oxalacetic acid, D-galacturonic acid, β-2,5-dihydroxy-DL-phenylalanine, L- and DL-citrulline from ornithine, and L- and D-penicillamine hydrochlorides. In the description of the latter, direct references to the original articles would have been better than indirect references to a book. In the preparation of isoleucine, the four stereoisomers are obtained with an optical purity of greater than 99.9 percent. Hydrolysis of L-arginine with sodium or barium hydroxides yields DL- or L-ornithine, respectively.

The purity and criteria for measuring the purity of the compounds are described. References are given to other methods of preparation. The volume contains a cumulative index and references to 64 compounds of biochemical interest appearing in 32 volumes of *Organic Syntheses*.

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New Books

The Papers of Wilbur and Orville Wright; Vol. I, *1899–1905;* Vol. II, *1906–1948.* Including the Chanute-Wright letters. Marvin W. McFarland, Ed. McGraw-Hill, New York–London, 1953. 1278 pp. Illus. + plates. $25.00 the set.

Advances in Protein Chemistry, Vol. VIII. M. L. Anson, Kenneth Bailey, and John T. Edsall, Eds. Academic Press, New York, 1953. 529 pp. Illus. $10.50.

Structure Reports for 1945–46, Vol. 10. A. J. C. Wilson, Gen. Ed.; C. S. Barrett (Metals), J. M. Bijvoet (Inorganic Compounds), and J. Monteath Robertson (Organic Compounds), Section Eds. Oosthoek, Utrecht, 1953. (For the International Union of Crystallography.) 325 pp. Illus. $12.00.

Lehrbuch der Botanik für Hochschulen. 26th ed. Hans Fitting *et al.*, Eds. Gustav Fischer, Stuttgart, 1954. 651 pp. Illus. DM 28.

Human Embryology. 2nd ed. Bradley M. Patten. Blakiston, New York, 1953. 798 pp. including 1400 drawings and photographs.

Selected Values of Physical and Thermodynamic Properties of Hydrocarbons and Related Compounds. Comprising the Tables of the American Petroleum Institute Research Project 44 Extant as of Dec. 31, 1952. Frederick D. Rossini *et al.* Carnegie Press, Carnegie Inst. of Technology, Pittsburgh, Pa., 1953. (Published for the American Petroleum Institute). 1050 pp. $7.00.

Mitosis. The movements of chromosomes in cell division. 2nd ed. Franz Schrader. Columbia Univ. Press, New York, 1953. 170 pp. Illus. $4.00.

A History of the Theories of Aether and Electricity: The Modern Theories, 1900–1926. Sir Edmund Whittaker. Thomas Nelson, Edinburgh–London; Philosophical Library, New York, 1954. 319 pp. $8.75.

Principles of Polymer Chemistry. Paul J. Flory. Cornell Univ. Press, Ithaca, New York, 1953. 672 pp. Illus. $8.50.

Rh-Hr Blood Types. Applications in clinical and legal medicine and anthropology. Selected articles in immunohematology. Alexander S. Wiener. Grune & Stratton, New York, 1954. 763 pp. Illus. $11.50.

Mechanical Vibrations. 2nd ed. William Tyrrell Thomson. Prentice-Hall, New York, 1953. 252 pp. Illus. $4.50.

Introduction to Dynamics. L. A. Pars. Cambridge Univ. Press, New York, 1953. 501 pp. Illus. $6.00.

Imidazole and Its Derivatives, Part I. The Chemistry of Heterocylic Compounds. Klaus Hofmann. Interscience, New York, 1953. 447 pp. $13.50.

Association Affairs

Association Business

Much of the business of the AAAS is conducted by the Board of Directors at meetings held four times a year. Minutes of the Board's meetings are sent to members of the Council to keep them informed of problems as they arise and decisions as they are made. But the Association as a whole has only the formal published reports of the annual meetings and occasional accounts of other particularly important items. That hardly seems enough. At the March meeting of the Board of Directors it was agreed that more frequent reporting to the entire membership was desirable. I do not want to write a regular monthly or weekly "column," but the Board agreed that from time to time I should publish in *Science* and *The Scientific Monthly* informal accounts of some of the problems, decisions, or other items of business before the Association.

The matter of a new building for AAAS headquarters has been under consideration ever since the Association purchased, in 1946, the old residence in which it is now housed. Since that purchase was made, District of Columbia zoning regulations have been changed so that we now need special permission to erect an office building on our property. In October 1952, an appeal to the Board of Zoning Adjustment for permission to erect an eight-story building was denied on technical grounds. Since then, the Building Committee, under John Dunning's chairmanship, has made a thorough-going examination of several alternative locations and considered various sizes and kinds of buildings. They recommended that the Association again appeal to the Board of Zoning Adjustment for permission to erect a four-story building which will be large enough to handle the Association's needs for the next 20 or more years. The Board approved, and a second appeal to the Board of Zoning Adjustment is under way.

Two matters of international cooperation were considered. In 1938 the AAAS and the British Asosciation for the Advancement of Science agreed to exchange lecturers at their annual meetings. In 1939 Isaiah Bowman went to England as the guest of the British Association. But he never gave his lecture; the meeting was abandoned when Germany walked into Poland and set off World War II. After the war's ending allowed the resumption of meetings, C. B. Fawcett came to the U.S. as a guest of the AAAS and lectured at the 1946 Boston meeting. But the agreement cost too much, and in recent years exchange lectures have been given only when travel for other reasons made it possible to invite a speaker without expense to the host association. A. V. Hill's lecture at the 1953 meeting was the most recent example. Neither association has funds with which to pay all of the expenses of an invited lecturer; but holding such lectures is desirable, and the Board decided to try to continue the practice by offering a supplementary honorarium to an invited speaker who expected to be in the U.S. for other purposes.

For some time there have been sporadic discussions of the possibility of establishing an international federation of associations for the advancement of science. The proposed federation would work closely with Unesco, and would probably pay more attention to problems of scientific education, international exchange of scientists and scientific information, and wider dissemination of knowledge of science than it would to questions of research and research support. Discussions with officers of some of the other associations and with Unesco officials have not yet led to definite decisions, either as to the advantages or the obligations of the proposed federation. The Board decided that further talks would be desirable before definite commitments were made.

For several years the Association has awarded the annual Westinghouse prizes of $1000 each for excellence of scientific writing in newspapers and magazines. Last year the Westinghouse Educational Foundation decided that the original purpose of the awards had been fairly well fulfilled and that 1953 was the last year in which they were willing to support the program. The desirability of stimulating good science writing continues, however, and the Board discussed various other ways of accomplishing the same end. One idea that appeared attractive, and that the staff was asked to study in detail, was for the AAAS to offer a series of prizes for excellence in science writing by undergraduate and graduate students.

Arrangements for the 1955 meeting were discussed in some detail because of the special problems raised when an association that observes no race or color distinctions in its membership and activities meets in a city in which segregation is a long-established custom. This problem had been considered by the Board before the initial decision to meet in Atlanta was reached. It was again discussed last December in both Board and Council meetings. As a result, Dr. Taylor was asked to go again to Atlanta to investigate in detail the kind of arrangements which could be made and the extent of difficulties which should be anticipated. After discussing these matters with a number of people in Atlanta, Dr. Taylor recommended that the Association proceed with plans to meet there in 1955. Facilities for meetings at Atlanta University and elsewhere are satisfactory; both Negro and white advisors urged us to come to Atlanta. After this review of the problem the Board again decided that holding a meeting in Atlanta would probably accomplish more toward breaking down discriminatory prejudices than would be achieved by moving the meeting to another city.

Probably the item of uppermost importance on the Association's calendar is the question of what kind of activities and programs should be given most emphasis and what kind of association the AAAS should

be. The Arden House meeting in 1951 charted a general course for the Association, and changes in the direction of the Arden House recommendations have been made, but not rapidly enough to satisfy many of the members. One of the puzzles has been the problem of choosing the machinery which will work most effectively in determining what changes should be made, how rapidly, and with what priority. In March the Board unanimously passed the following motion and ordered it to be printed.

> Moved that the Board request the Administrative Secretary, with such staff and other assistance as he considers appropriate, to study the assignment placed upon the Board of Directors by the findings of the Arden House Conference, and present to the Board suggestions for necessary or desirable changes in *a*) meetings; *b*) publications; *c*) facilities and methods for services by AAAS to members and constituent societies, including the integrating influence of the Association among the sciences; *d*) facilities and methods of the AAAS for improving the general public understanding of science.
>
> Moved, further, that the Administrative Secretary in the light of suggestions on the four points listed above determine whether other steps are desirable such as appointment of special committees or the undertaking of other activities by the Board of Directors, in order that the greatest possible benefit may be derived by the Association from the Arden House study.

That action certainly places primary responsibility in one spot. There will be more to report later, after I have had time to digest the recommendations of as many members as I can get to talk about the kind of AAAS meetings, publications, and activities they believe would be most effective and useful.

DAEL WOLFLE
Administrative Secretary

Transportation to the AAAS Meeting in Berkeley, California, December 26–31, 1954 —and Call for Papers

Raymond L. Taylor
Associate Administrative Secretary

The decision to hold the 121st meeting of the Association this December in Berkeley, California, was not made without careful preliminary study, the hearty approval of the AAAS Pacific Division and its constituent scientific societies, and the generous offer of the University of California to make use of its facilities. It is now assured that this first national winter meeting of the AAAS west of the Rockies will have well-appointed session rooms, inexpensive housing in dormitories, hotels, and motels, and ample eating facilities on and off campus—all in one convenient area, across the Bay Bridge from San Francisco.

Since one out of each nine members of the Association resides on the Pacific Coast, the logic of meeting there, when circumstances permit, is cogent. For years West Coast scientists have attended scientific meetings in other parts of the United States and have pointed out, "It really is no farther from New York to San Francisco than it is from San Francisco to New York." With the present schedules of air transport and coach fares it is not impractical or unduly expensive for AAAS members on one coast to travel to the other coast; they can still be home on Christmas day, on New Year's, or both.

Next month's preliminary announcement will outline the programs of the 18 sections and many participating organizations, including the Third Berkeley Symposium on Mathematical Statistics and Probability, the statistical societies, the American Physical Society, American Society of Limnology and Oceanography, Society of Systematic Zoology—and some 60 others.

One purpose of this notice is to call attention to the page in the advertising section of this issue which outlines the transportation possibilities and includes a coupon to indicate interest in securing the substantial savings possible by the AAAS chartering sections of regular flights—or in the pleasure of traveling with colleagues in the same railroad car. Another object:

CALL FOR PAPERS BY AAAS SECTIONS

The following sections of the Association will have sessions for contributed papers. The secretaries or program chairmen to whom titles and brief abstracts should be sent, *not later than September 30, 1954*, follow:

C—Chemistry. Dr. Ed. F. Degering, 12 Grove St., Natick, Mass.

E—Geology and Geography. Dr. Jack B. Graham, Room 516, 551 Fifth Ave., New York 17.

F—Zoological Sciences. (If outside the scope of Society of Systematic Zoology and Western Society of Naturalists) Dr. Joseph H. Bodine, State University of Iowa, Iowa City.

G—Botanical Sciences. (If outside the scope of American Society of Plant Physiologists' Western Section, American Phytopathological Society's Pacific Division, and Mycological Society of America) Dr. Barry Commoner, Washington University, St. Louis, Mo.

H—Anthropology. Dr. Gabriel Lasker, Wayne University College of Medicine, 1401 Rivard St., Detroit 7, Mich.

I—Psychology. Dr. William D. Neff, Department of Psychology, University of Chicago, Chicago 37, Ill.

L—History and Philosophy of Science. Dr. Raymond J. Seeger, 4507 Wetherill Road, Washington 16, D.C.

Nd—Dentistry. Dr. Russell W. Bunting, School of Dentistry, University of Michigan, Ann Arbor.

Np—Pharmacy. Dr. Glenn L. Jenkins, Purdue University, Lafayette, Ind.

O—Agriculture. Dr. F. D. Keim, College of Agriculture, University of Nebraska, Lincoln.

Q—Education. Dr. D. A. Worcester, University of Nebraska, Lincoln.

Animal Venom Conference—AAAS Sections F and N—Medical Sciences are cosponsoring a three-day Symposium on Animal Venoms—all phases of the venoms of poisonous reptiles, arthropods, fishes, and other animals. Titles and abstracts of papers, which can be read *in absentia* if necessary, should be submitted to Dr. Nandor Porges, 1301 E. Barringer St., Philadelphia 19, Pa.

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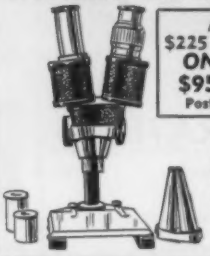

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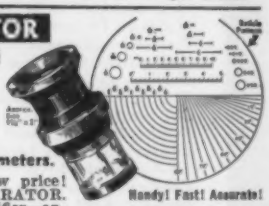

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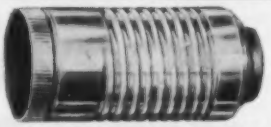

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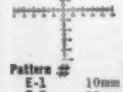

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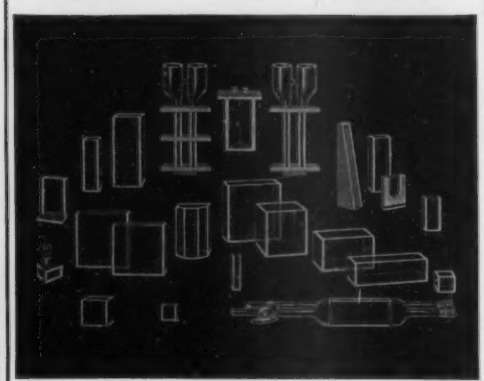

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The International Geophysical Year, 1957–58

THE International Geophysical Year 1957–58 will be the successor, after a 25-year interval, of the Second Polar Year (1932–33), 50 years after the First Polar Year (1882–83). Studies during these polar years, largely in the north polar regions, were concerned with meteorology, geomagnetism, aurora and, in 1932–33, the ionosphere. The present international program calls for worldwide observations and measurements in some 10 fields of geophysics.

The basic philosophy of the program has been to plan observations that will replace the long-time averages of geophysical observations, taken at relatively few locations on the earth and limited in frequency as well, by an increased spread of observations in space and by a carefully planned increase in the frequency of these observations. We might say that time will, in a sense, be replaced by space. An important consideration in the preliminary formulation of the international program has been, quite properly, the need for synoptic data in the several fields, both individually and collectively.

The principal disciplines in the program are solar activity, longitude and latitude determinations, meteorology, oceanography, glaciology, ionospheric physics, aurora and airglow, geomagnetism, cosmic rays, and rocket exploration of the upper atmosphere. During the 1957–58 period of intensive study, a plan of World Days will insure simultaneous observations in affected fields when unusual geophysical activity is prevalent—for example, intervals of unusual magnetic, ionospheric, auroral, or solar activity and disturbances.

The U.S. National Committee (USNC) for the IGY, which was formed in Feb. 1953, by the National Academy of Sciences–National Research Council to develop the American program, had as its first task the preparation of tentative proposals for submission to the Special Committee for the International Geophysical Year (CSAGI) of the International Council of Scientific Unions. The haste which these proposals were prepared is indicated by the fact that the Special Committee considered them, along with those submitted by other national committees, at a meeting in Brussels last June 30–July 3.

On Nov. 5 and 6, the USNC met again to discuss the draft resolutions adopted by the CSAGI at Brussels. In addition, it appointed a coordinating group to develop and draft the scientific program to be carried out by the United States. Members of this group were designated as reporters on specific portions of the program. Members of both the committee and the coordinating group are listed elsewhere in this issue.

The subsequent activities of the USNC and its reporters have been dictated by a series of deadlines, the first of which was the presentation of the program to the National Science Board on Dec. 7, 1953. This was the result of a recommendation by the NAS–NRC that the National Science Foundation be the agency responsible for obtaining Federal support. The Board responded favorably and asked the USNC to prepare a detailed program and budget for presentation at its meeting on Jan. 29. This request was carried out, and the Board accepted the NAS–NRC recommendation. The reporters were again called upon to help in the preparation of a more detailed program and budget document.

The USNC will meet again on April 8 and 9 to adopt and revise the scientific program to be sent to the secretary general of the CSAGI by May 15. This will be considered, with the reports of more than 28 other national committees, at a meeting of the CSAGI in Rome, Oct. 1–4.

In an article to be published in *Science*, L. V. Berkner, vice president of the CSAGI, will present other aspects of this important international scientific effort. The writer, chairman of the USNC, has been ably and generously assisted by the combined staffs of the NSF and the NAS–NRC, and in particular by Alan Shapley, vice chairman, and Hugh Odishaw, administrative secretary, during these hectic and harried months. It is hoped that this brief summary, together with other articles which will appear from time to time, will give readers of *Science* a feeling for the scope and importance of the IGY, and a desire to help with their comments, criticisms, and participation.

JOSEPH KAPLAN, *Chairman*
U.S. National Committee
International Geophysical Year
University of California, Los Angeles

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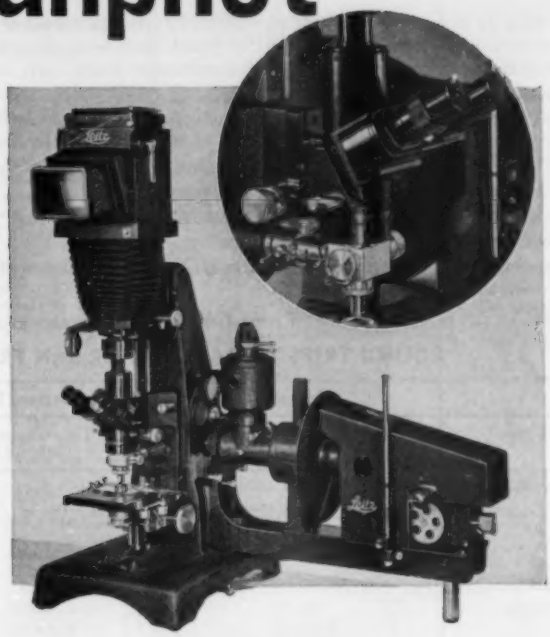

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TRAVEL ARRANGEMENTS FOR THE AAAS BERKELEY MEETING

December 26-31, 1954

In time or in cost, a trip from an eastern city to California is not much more than a **round trip** to a midwestern city. Californians who for years have been attending meetings in the East have told their colleagues that the continental distance is the **same** each way, and that it should be the turn of the Easterners to visit the Pacific Coast.

The Association is planning ways it may assist those who will attend the 121st AAAS Meeting on the campus of the University of California at Berkeley, this December. The possibilities include:

1. Low cost AAAS limousines from Oakland and San Francisco airports and railroad terminals direct to the dormitory or hotel of each delegate.
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Total	$185.30	$264.39	$286.25
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Air coach (no meals)	$167.20	$215.60	$217.80
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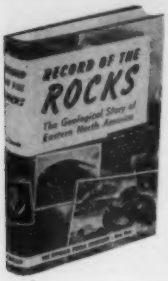

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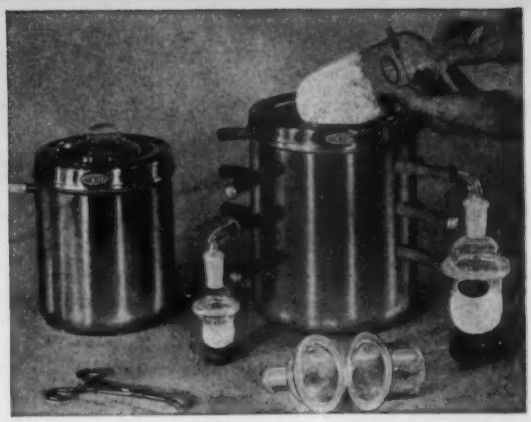

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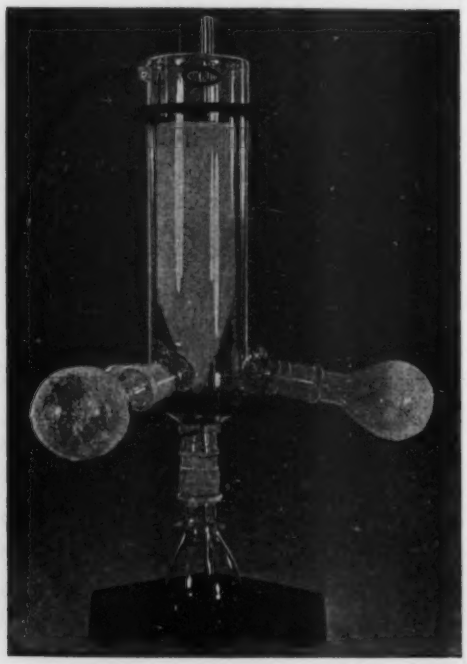

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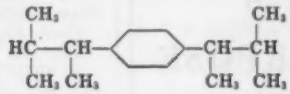

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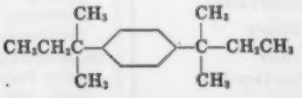

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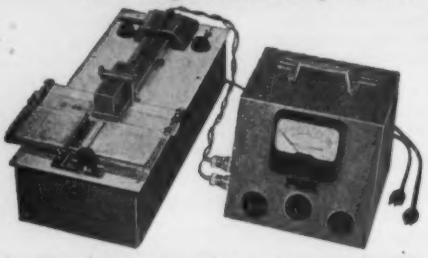

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Miscellaneous Publications

Development and Field Tests of a Sampler for Suspended Sediment in Wave Action. Tech. Memo. No. 34. 41 pp. Illus. ***Areal and Seasonal Variations in Beach and Nearshore Sediments at La Jolla, California.*** T. M. No. 39. 82 pp. + appendices. Illus. Beach Erosion Board, Corps of Engineers, Washington 25, D.C., 1953.

Federal Funds for Science, II. The Federal Research and Development Budget, Fiscal Years 1952–53. National Science Foundation, Washington 25, D.C., 1953. 43 pp. Illus.

Geologic Aspects of Radio Wave Transmission. Report of Investigations, No. 162. M. William Pullen. State Geological Survey, Urbana, Ill., 1953. 73 pp. Illus.

Health Manpower Source Book. Section 2: ***Nursing Personnel.*** Public Health Service Pub. No. 263. Prepared by Helen G. Tibbitts and Eugene Levine. Government Printing Office, Washington 25, D.C., 1953. 88 pp. 40¢.

Joint UN/WHO Meeting of Experts on the Mental-Health Aspects of Adoption. Final Report. Tech. Rep. Ser., No. 70. 19 pp. 15¢. ***Expert Committee on Leprosy.*** First Report. T.R.S., No. 71, 28 pp. 20¢. ***Joint FAO/WHO Expert Committee on Nutrition.*** Third Report. T.R.S., No. 72. 30 pp. 20¢. World Health Organization, Geneva, 1953.

Manual of the Classified Abstract Archive of the Alcohol Literature. Mark Keller, Vera Efron and E. M. Jellinek. Quarterly Journal of Studies on Alcohol, New Haven, Conn., 1953. 56 pp. Illus. $1.00.

Mental Health Implications in Civilian Emergencies. Public Health Service Pub. No. 310. Government Printing Office, Washington 25, D.C., 1953. 25 pp. 15¢.

Notes on Flowering and Fruiting of Northeastern Trees. Station Paper No. 60. Jonathan W. Wright. 38 pp. Illus. ***Five Years of Research on the Fernow Experimental Forest.*** S.P. No. 61. Sidney Weitzman. 44 pp. Illus. ***How Second-growth Northern Hardwoods Develop after Thinning.*** S.P. No. 62. Robert W. Wilson, Jr. 12 pp. Illus. Northeastern Forest Experiment Station, Upper Darby, Pa., 1953.

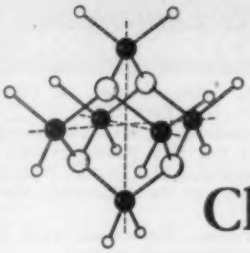
Origin and Destination Surveys: Methods and Costs. Highway Research Board Bull. 76. 65 pp. Illus. 90¢. ***Right-of-Way Problems.*** Bull. 77. 72 pp. Illus. ***Travel to Commercial Centers.*** Bull. 79. 38 pp. Illus. National Academy of Sciences, National Research Council, Washington 25, D.C., 1953.

Phase-Equilibria: Collected Research Papers for 1953. Chem. Eng. Progress Symposium Ser., No. 6, Vol. 49. American Institute of Chemical Engineers, New York 17, 1953. 113 pp. Illus.

The Pleistocene Fauna of Wailes Bluff and Langleys Bluff, Maryland. Smithsonian Misc. Coll., Vol. 121, No. 12. S. F. Blake. 32 pp. Illus. ***The External Morphology of the Dragonfly*** Onychogomphus ardens **Needham.** Vol. 122, No. 6. Hsiu-Fu Chao. 56 pp. Illus. Smithsonian Institution, Washington, D.C., 1953.

Regulas de Selection pro Spectros Vibrational de Moleculas Polyatomic. (In Interlingua). Forrest F. Cleveland. The author, Spectroscopy Laboratory, Illinois Institute of Technology, Chicago 16, Ill., 1953. 21 pp. 75¢.

Seventh Annual Report to American Cancer Society. Committee on Growth of the National Research Council. Washington, D. C.: Division of Medical Sciences, National Research Council, 1953. 299 pp.



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2–6. Electrochemical Soc., spring, Chicago, Ill. (H. B. Linford, Columbia Univ., New York 27.)

2–7. Soc. of American Bacteriologists, annual, Pittsburgh, Pa. (F. S. Cheever, P.O. Box 1912, Pittsburgh 30.)

3–5. American Geophysical Union, 35th annual, Washington, D.C. (J. Adkins, Office of Naval Research, Washington 25.)

3–6. Air Pollution Control Assoc., Chattanooga, Tenn. (H. C. Ballman, 4400 5 Ave., Pittsburgh 13, Pa.)

3–6. International Scientific Radio Union (USA National Comm.) and Inst. of Radio Engineers (PGMTT), Washington, D.C. (W. E. Gordon, School of Electrical Engineering, Cornell Univ., Ithaca, N.Y.)

3–7. American Psychiatric Assoc., annual, St. Louis, Mo. (R. F. Gayle, Jr., Professional Bldg., Richmond 19, Va.)

3–7. Soc. of Motion Picture and Television Engineers, semiannual, Washington, D.C. (Sec., 342 Madison Ave., New York 17.)

4–6. Electronic Components Symposium, Washington, D.C. (F. B. Haynes, Glenn L. Martin Co., Baltimore 3, Md.)

5–7. American Inst. of Electrical Engineers, northeastern district, Schenectady, N.Y. (H. H. Henline, 33 W. 39 St., New York 8.)

5–7. Forest Products Research Soc., annual, Grand Rapids, Mich. (F. J. Rovsek, Box 2010, University Station, Madison 5, Wis.)

5–8. National Conf. on Health in Colleges, 4th, New York, N.Y. (Sec., American College Health Assoc., 1790 Broadway, New York 19.)

6–8. American Philosophical Assoc., Urbana, Ill. (M. C. Nahm, Bryn Mawr College, Bryn Mawr, Pa.)

7–8. North Carolina Academy of Science, Greenville, N.C. (J. A. Yarbrough, Meredith College, Raleigh.)

7–8. North Dakota Acad. of Science, Fargo, N.D. (J. D. Henderson, University Station, Grand Forks.)

7–8. Soc. for American Archaeology, Albany, N.Y. (J. B. Griffin, University Museum Bldg., Ann Arbor, Mich.)

8–9. Population Assoc. of America, annual, Charlottesville, Va. (H. Carter, National Office of Vital Statistics, Dept. of Health, Education, and Welfare, Washington 25, D.C.)

9–14. National Conf. of Social Work, 81st annual, Atlantic City, N.J. (Office, 22 W. Gay St., Columbus 15, Ohio.)

10–12. IRE National Conf. on Airborne Electronics, Dayton, Ohio. (H. Pratt, 800 Quaint Acres Dr., Silver Spring, Md.)

10–12. Symposium on Fluorides, Cincinnati, Ohio. (Sec., Inst. of Industrial Health, Eden and Bethesda Aves., Cincinnati 19.)

12–22. International Conf. on Large Electric Systems, CIGRE, Paris, France. (F. Attwood, 50 Church St., New York 7.)

13–15. National Science Fair, 5th, Lafayette, Ind. (Science Clubs of America, 1719 N St., NW, Washington 6, D.C.)

14–16. American Acad. of Dental Medicine, 8th annual, Philadelphia, Pa. (W. M. Greenhut, 124 E. 84 St., New York 28.)

(See the March 19th issue for summer meeting lists.)

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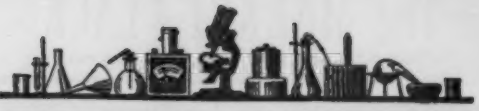

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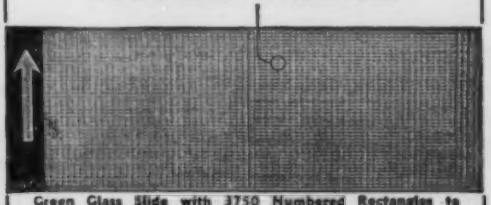

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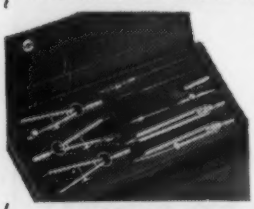

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